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PART II

Department of Health, Education, and Welfare

Office of the Secretary

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Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines

Title 45—PUBLIC WELFARE

Subtitle A—Department of Health, Education, and Welfare, General Administration

PART 85—CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND NEW MOTOR VEHICLE ENGINES

Subpart H—Test Procedures for Vehicle and Engine Exhaust and Fuel Evaporative Emissions (Gasoline Engines) (Light Duty Vehicles)

SAMPLING AND ANALYTICAL SYSTEM (EXHAUST EMISSIONS)

On March 30, 1966, 45 CFR Part 85 was adopted establishing regulations for the control of air pollution from new motor vehicles and new motor vehicle engines. The standards so promulgated were applicable to the model years beginning with 1968 and dealt with crankcase emissions and exhaust emissions from gasoline-powered vehicles. Motor vehicles with an engine displacement of less than 50 cubic inches, commercial vehicles over one-half ton or equivalent, and motorcycles were excepted from compliance with the exhaust emission standards; motorcycles subsequently were excepted from the crankcase emission standards.

On June 4, 1968, 45 CFR Part 85 was amended to establish new regulations for the control of exhaust emissions from gasoline-powered vehicles and engines, exhaust smoke from diesel engines designed for use in commercial vehicles having a gross vehicle weight rating of more than 6,000 pounds, and for the control of fuel evaporative emissions from light-duty vehicles. Standards applicable to exhaust emissions from light-duty vehicles were revised. The standards so promulgated are applicable to the model years beginning with 1970 (1971 for fuel evaporative emissions). Motorcycles are excepted.

The standards now applicable to exhaust emissions from light-duty vehicles are expressed on a mass basis. Current test procedures provide for measurements of emission concentrations during specified portions of test vehicle dynamometer operation. A calculated exhaust volume, theoretically relating exhaust flow to vehicle weight, together with average measured pollutant concentrations, are used to compute emissions on a mass basis for comparison with the mass standards.

The Department has for some time recognized that mass-based standards dependent upon calculated exhaust volumes do not provide equitable treatment for all light-duty vehicles. Accordingly, in 1968 it was announced to domestic and foreign automobile manufacturers that a true mass-measurement procedure for determining exhaust emissions would be developed for application to 1972 model year light-duty vehicles. This announcement was reiterated by the Department in a presentation to the California Air Resources Board in November 1968. A preliminary draft of such a procedure was forwarded by letter of June 25, 1969, to all manufacturers and to the California Air Resources Board.

On February 10, 1970, advance notice of proposed rule-making to provide for true mass measurement of exhaust emissions applicable to 1972 and subsequent model year light-duty vehicles and engines was published.

Development of the previously announced sampling and analytical system has now been completed, and is set forth in the revision below. The system is essentially unchanged from that forwarded to all manufacturers by letter of June 25, 1969, following the consideration of their comments to a draft forwarded on April 3, 1969. No controversy exists concerning the suitability of the system for obtaining samples of exhaust gases and for measuring those samples. The manufacturers have maintained that because of the limited commercial availability of some of the instrumentation and other equipment employed in this system, the Department must prescribe the system at the earliest date possible in order to provide them sufficient time for acquisition of and familiarization with the equipment. Since the issue is the adequacy of lead time and not the merits of the sampling and analytical system, the Department finds that notice and comment are unnecessary and that good cause exists for the adoption of this revision effective upon publication in the FEDERAL REGISTER.

Development of the previously announced dynamometer driving schedule which is representative of urban driving practices and which is closed and self-weighting has been completed and is separately proposed in this Part II section of the FEDERAL REGISTER.

Accordingly, the revision of 45 CFR Part 85 as set forth below is hereby adopted, effective on publication in the FEDERAL REGISTER, and is applicable to 1972 and subsequent model year light-duty vehicles and engines. The current regulations which appear at 45 CFR Part 85 will remain in effect for the purpose of their applicability to 1970 and 1971 model year vehicles and engines.

(Sec. 2, Public Law 90-148, 81 Stat. 504; 42 U.S.C. 1857g(a))

Dated: July 6, 1970.

ELLIOT L. RICHARDSON,
Secretary.

In Title 45 of the Code of Federal Regulations, § 85.81 is revised to read as follows:

§ 85.81 Sampling and analytical system (exhaust emissions).

(a) *Schematic drawings.* The following figures (Figures 1a and 1b) are schematic drawings of the exhaust gas sampling and analytical systems which will be used for testing under the regulations in this part. Additional components such as instruments, valves, solenoids, and switches may be used to coordinate the functions of the component systems.

(b) *Component description (exhaust gas sampling system).* The following components will be used in the exhaust gas sampling system for testing under the regulations in this part. See Figure 1a.

(1) A dilution air filter assembly consisting of a particulate (paper) filter to remove solid matter from the dilution air and thus increase the life of the charcoal filter; a charcoal filter to reduce and stabilize the background hydrocarbon level; a second particulate filter to remove charcoal particles from the air stream. The dilution air filter assembly is not required when the dilution air hydrocarbon level is below 15 p.p.m. carbon equivalent.

(2) A flexible, leak-tight connector tube to the vehicle tailpipe.

(3) A heating system to preheat the heat exchanger to within ±10° F. of its operating temperature before the test begins.

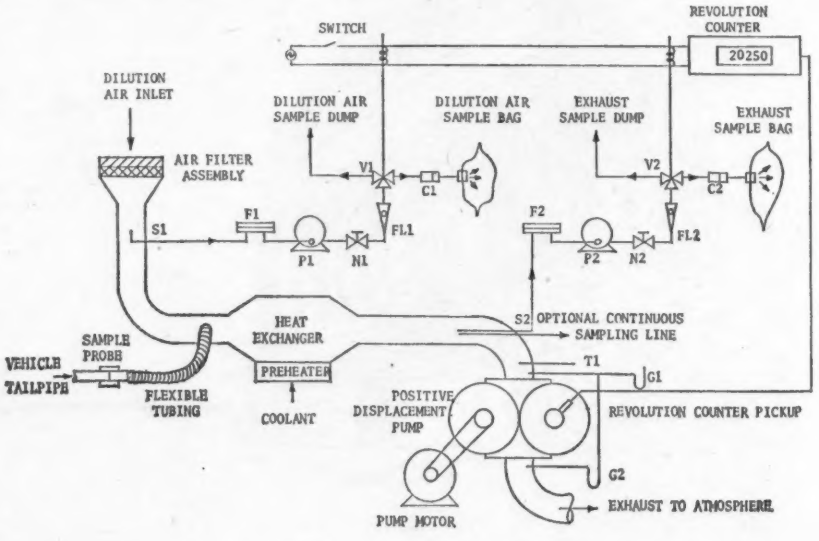

Figure 1a. Exhaust Gas Sampling System

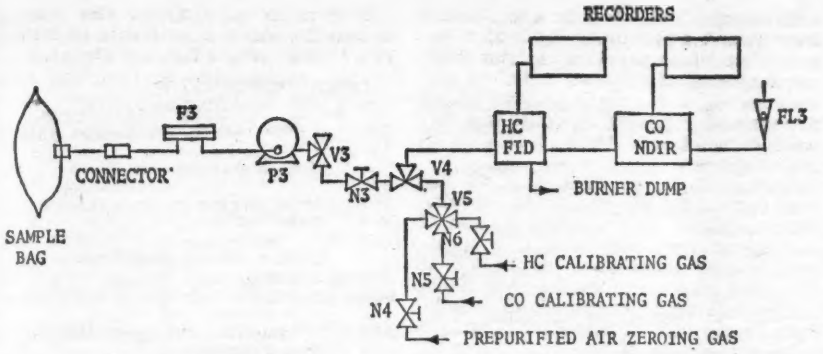

Figure 1b. Exhaust Gas Analytical System

(4) A heat exchanger capable of limiting the gas mixture temperature variation during the entire test to ±10° F. as measured at a point immediately ahead of the positive displacement pump.

(5) A 300 to 350 c.f.m. positive displacement pump to pump the dilute exhaust mixture. A smaller pump or a multispeed (not continuously variable) drive motor may be substituted for testing smaller vehicles. The overall dilution ratio must be a minimum of 8:1 to minimize the possibility of water condensation in the system.

(6) Temperature sensor (T1) with an accuracy of ±2° F. to allow continuous recording of the temperature of the dilute exhaust mixture entering the positive displacement pump.

(7) Gauge (G1) with an accuracy of ±1 mm. Hg to measure the pressure depression of the dilute exhaust mixture entering the positive displacement pump, relative to atmospheric pressure.

(8) Gauge (G2) with a accuracy of ±1 mm. Hg to measure the pressure increase across the positive displacement pump.

(9) Sample probes (S1 and S2) to collect samples from the dilution air stream and the dilute exhaust mixture. The probes shall be pointed upstream and sized so that the gas velocity in the probe inlet is within ±25 percent of the bulk stream velocity. Additional sample probes may be used, for example, to obtain continuous concentration traces of the dilute exhaust stream. In such case the sample flow rate, in standard cubic feet per test, must be added to the calculated dilute exhaust volume.

(10) Filters (F1 and F2) to remove particulate matter from dilution air and dilute exhaust samples prior to entering sample collection bags.

(11) Pumps (P1 and P2) to pump the dilution air and dilute exhaust into their respective sample collection bags.

(12) Flow control valves (N1 and N2) to regulate flows to sample collection bags, at constant flow rates. The minimum sample flow shall be 5 c.f.h.

(13) Flowmeters (FL1 and FL2) to insure, by visual observation, that constant flow rates are maintained throughout the test.

(14) Three-way solenoid valves (V1 and V2) to direct sample streams to either their respective bags or overboard.

(15) Quick-connect leak-tight fittings (C1 and C2) to attach sample bags to sample system.

(16) Sample collection bags for dilution air and exhaust samples of sufficient capacity so as not to impede sample flow.

(17) A revolution counter to count the revolutions of the positive displacement pump while the test is in progress and samples are being collected.

(c) *Component description (exhaust gas analytical system).* The following components will be used in the exhaust gas analytical system for testing under the regulations in this part. The analytical system provides for the determination of hydrocarbon concentrations by flame ionization detector (FID) analysis and the determination of carbon monoxide concentrations by nondispersive infrared (NDIR) analysis in dilute exhaust samples. See Figure 1b.

(1) Filter (F3) to remove any residual particulate matter from the collected samples.

(2) Pump (P3) to transfer samples from the sample bag to the analyzers.

(3) Selector valves (V3, V4, and V5) for directing sample and calibrating gases or zeroing gas to the analyzers.

(4) Flow control valves (N3, N4, N5, and N6) to regulate flows to a constant rate of 5 c.f.h.

(5) A flame-ionization-detector type analyzer to measure HC concentrations.

(6) A carbon monoxide sensitized nondispersive infrared analyzer to measure CO concentrations.

(7) Flowmeter (F3) to indicate sample flow rate.

(8) Recorders to provide permanent records of calibration, spanning and sample measurements.

[F.R. Doc. 70-8933; Filed, July 14, 1970; 8:45 a.m.]

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of the Secretary

[45 CFR Part 85]

CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND NEW MOTOR VEHICLE ENGINES

Notice of Proposed Rule Making

On March 30, 1966, 45 CFR Part 85 was adopted establishing regulations for the control of air pollution from new motor vehicles and new motor vehicle engines. The standards so promulgated were applicable to the model years beginning with 1968 and dealt with crankcase emissions and exhaust emissions from gasoline-powered vehicles. Motor vehicles with an engine displacement of less than 50 cubic inches, commercial vehicles over one-half ton or equivalent, and motorcycles were excepted from compliance with the exhaust emission standards; motorcycles subsequently were excepted from the crankcase emission standards.

On June 4, 1968, 45 CFR Part 85 was amended to establish new regulations for the control of exhaust emissions from gasoline-powered vehicles and engines, exhaust smoke from diesel engines designed for use in commercial vehicles having a gross vehicle weight rating of more than 6,000 pounds, and for the control of fuel evaporative emissions from light-duty vehicles. Standards applicable to exhaust emissions from light-duty vehicles were revised. The standards so promulgated are applicable to the model years beginning with 1970 (1971 for fuel evaporative emissions). Motorcycles are excepted.

The standards now applicable to exhaust emissions from light-duty vehicles are expressed on a mass basis. Current test procedures provide for measurements of emission concentrations during specified portions of test vehicle dynamometer operation. A calculated exhaust volume, theoretically relating exhaust flow to vehicle weight, together with average measured pollutant concentrations, are used to compute emissions on a mass basis for comparison with the mass standards.

The Department has for some time recognized that mass-based standards dependent upon calculated exhaust volumes do not provide equitable treatment for all light-duty vehicles. Accordingly, in 1968 it was announced to domestic and foreign automobile manufacturers that a true mass-measurement procedure for determining exhaust emissions would be developed for application to 1972 model year light-duty vehicles. A preliminary draft of such a procedure was forwarded by letter of June 25, 1969, to all manufacturers.

On February 10, 1970, advance notice of proposed rulemaking to provide for true mass-measurement of exhaust emissions applicable to 1972 and subsequent model year light-duty vehicles and engines was published in the FEDERAL REGISTER. A preliminary draft of a test procedure which provides for true mass-measurement of exhaust emissions and employs a new, closed self-weighting dynamometer driving schedule was forwarded, by letter of April 22, 1970, to all manufacturers.

Section 85.81, 45 CFR Part 85 has been revised for the purpose of adopting the sampling and analytical portion of the previously announced true mass-measurement procedure, applicable to 1972 and subsequent model year light-duty vehicles and engines, and is published separately in this Part II section of the FEDERAL REGISTER.

Notice is hereby given that: It is now proposed to amend the regulations in 45 CFR Part 85 in order to:

(a) Establish a true mass-measurement procedure applicable to light-duty vehicles which employs a closed self-weighting dynamometer driving schedule representative of urban driving practices.

(b) Establish revised exhaust emission standards for light-duty vehicles to correspond with the new mass-measurement procedure.

(c) Establish revised fuel evaporative emission standards for light-duty vehicles.

(d) Require that each vehicle or engine subject to testing comply with the applicable standard before any vehicle or engine in its class is certified.

(e) Establish new criteria for selection of vehicles and engines required to be tested.

(f) Require new, more realistic, mileage accumulation procedures for light-duty vehicles subject to testing.

(g) Establish minimum deterioration factors for computing emissions for vehicles and engines for which there are applicable standards.

(h) Provide for inspection of the manufacturer's testing facilities and observation of vehicle tests and maintenance.

(i) Implement the recordkeeping and reporting provisions of section 207 of the Act.

(j) Require the manufacturer to make available test vehicles to be under the control of the Secretary in accumulating the requisite mileage.

45 CFR Part 85 as revised by the proposed amendments will become effective on republication and will be applicable to 1972 and subsequent model year motor vehicles and engines. The current regulations which appear at 45 CFR Part 85 will remain in effect for the purpose of their applicability to 1970 and 1971 model year vehicles and engines.

Interested persons may submit written data, views, or arguments (in quadruplicate) in regard to the proposed regulations to the Secretary of Health, Education, and Welfare, Washington, D.C. 20201. All relevant material received not later than 60 days after the publication of this notice will be considered. Comments are particularly invited with respect to any substantial problems of technological feasibility and/or economic cost related to the proposed 1972 hydrocarbon and carbon monoxide emission standards for light duty vehicles.

This notice of proposed rule making is issued under the authority of section 301, 81 Stat. 504, 42 U.S.C. 1857g(a).

Dated: June 29, 1970.

JOHN T. MIDDLETON,
Commissioner.

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Appendix A—DHEW Urban Dynamometer Driving Schedule.

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Appendix C—Durability Driving Schedule.

AUTHORITY: The provisions of this Part 85 issued under sec. 301, 81 Stat. 504, 42 U.S.C. 1857g(a).

Subpart A—General Provisions

§ 85.1 Definitions.

(a) As used in this part, all terms not defined herein shall have the meaning given them in the Act:

(1) "Act" means the National Emission Standards Act (Title II of the Clean Air Act as amended), 42 U.S.C. 1857f–1 et seq.

(2) "Secretary" means the Secretary of Health, Education, and Welfare and any other officer or employee of the Department of Health, Education, and Welfare to whom the authority involved may be delegated.

(3) "Model year" means the production period of new motor vehicles or new motor vehicle engines designated by the calendar year in which such period ends: *Provided*, That if the manufacturer does not designate a production period the model year with respect to such vehicles or engines shall mean the 12-month period beginning January 1 of the year in which production begins.

(4) "Gross vehicle weight" means the manufacturer's gross weight rating.

(5) "Light duty vehicle" means any motor vehicle either designed primarily for transportation of property and weighing 6,000 pounds GVW or less or designed primarily for transportation of persons and having a capacity of 12 persons or less.

(6) "Heavy duty vehicle" means any motor vehicle not meeting the definition of a light duty vehicle.

(7) "Heavy duty engine" means any engine which the engine manufacturer could reasonably expect to be used in a heavy duty vehicle.

(8) "Off-road utility vehicle" means a light duty vehicle which incorporates special features for off-road operation such as four-wheel drive.

(9) "Motorcycle" means any light duty vehicle designed primarily for operation on two wheels.

(10) "Vehicle curb weight" means the actual or the manufacturer's estimated weight of the vehicle in operational status with all standard equipment, and weight of fuel at nominal tank capacity, and the weight of optional equipment computed in accordance with § 85.89(g).

(11) "Loaded vehicle weight" means the vehicle curb weight of a light duty vehicle plus 300 pounds.

(12) "System" includes any motor vehicle engine modification which controls or causes the reduction of substances emitted from motor vehicles or motor vehicle engines.

(13) "Engine family" means the basic classification unit of a manufacturer's product line used for the purpose of test fleet selection and determined in accordance with § 85.89(a).

(14) "Engine-system combination" means an engine family-exhaust emission control system-fuel evaporative emission control system (where applicable) combination.

(15) "Fuel system" means the combination of fuel tank, fuel pump, fuel lines, and carburetor, or fuel injection components, and includes all fuel system vents and fuel evaporative emission control systems.

(16) "Crankcase emissions" means substances emitted to the atmosphere from any portion of the engine crankcase ventilation or lubrication systems.

(17) "Exhaust emissions" means substances emitted to the atmosphere from any opening downstream from the exhaust port of a motor vehicle engine.

(18) "Fuel evaporative emissions" means vaporized fuel emitted into the atmosphere from the fuel system of a motor vehicle.

(19) "Smoke" means the matter in exhaust emissions which obscures the transmission of light.

(20) "Hot soak loss" means fuel evaporative emissions during the 1-hour hot soak period which begins immediately after the engine is turned off.

(21) "Diurnal breathing loss" means fuel evaporative emissions as a result of the daily range in temperature to which the fuel system is exposed.

(22) "Running loss" means fuel evaporative emissions resulting from an average trip in an urban area or the simulation of such a trip.

(23) "Tank fuel volume" means the volume of fuel in the fuel tank, prescribed to be 40 percent of nominal tank capacity rounded to the nearest whole U.S. gallon.

(24) "Maximum rated horsepower" means the maximum brake S.A.E. horsepower output of an engine as stated by the manufacturer in his sales and service literature and his application for certification under § 85.51.

(25) "Rated speed" means the speed at which the manufacturer specifies the maximum rated horsepower of an engine.

(26) "Maximum rated torque" means the maximum torque produced by an engine as stated by the manufacturer in his sales and service literature and his application for certification under §85.51.

(27) "Opacity" means the fraction of a beam of light, expressed in percent, which fails to penetrate a plume of smoke.

§ 85.2 Abbreviations.

The abbreviations used in this part have the following meanings in both capital and lower case:

Accel.—Acceleration.
ASTM—American Society for Testing and Materials.
BHP—Brake Horsepower.
C.f.h.—Cubic feet per hour.
CO_2—Carbon Dioxide.
CO—Carbon Monoxide.
Conc.—Concentration.
CT—Closed Throttle.
C.f.m.—Cubic feet per minute.
Cu.in.—Cubic inch(es).
Decel.—Deceleration.
EP—End Point.
Evap.—Evaporated.
F.—Fahrenheit.
FL—Full Load.
Gal.—U.S. Gallon(s).
Gm.—Gram(s).
GVW—Gross Vehicle Weight.
HC—Hydrocarbon(s).
Hg—Mercury.
Hi.—High.
HP.—Horsepower.
IBP—Initial Boiling Point.
ID—Internal Diameter.
Lb.—Pound(s).
Lb.-ft.—Pound-feet.
Max.—Maximum.
Min.—Minimum; also minute(s).
Ml.—Milliliter(s).
M.p.h.—Miles per hour.
Mm.—Millimeter(s).
Mv.—Millivolt(s).
N_2—Nitrogen.
No.—Number.
Pb—Lead.
P.p.m.—Parts per million by volume.
P.s.i.—Pounds per square inch.
P.s.i.g.—Pounds per square inch gauge.
PTA—Part Throttle Accel.
PTD—Part Throttle Decel.
R—Rankine.
R.p.m.—Revolutions per minute.
RS—Rated Speed.

RVP—Reid Vapor Pressure.
S.A.E.—Society of Automotive Engineers.
Sec.—Second(s).
Sp.—Speed.
SS—Stainless Steel.
T—Torque.
TEL—Tetraethyl Lead.
TML—Tetramethyl Lead.
V.—Volts.
Vs.—Versus.
WOT—Wide Open Throttle.
Wt.—Weight.
'—Feet.
"—Inches.
°—Degrees.
%—Percent.

§ 85.3 General standards: increase in emissions; unsafe conditions.

(a) (1) Every new motor vehicle or new motor vehicle engine manufactured for sale, sold, offered for sale, introduced or delivered for introduction into commerce, or imported into the United States for sale or resale which is subject to any of the standards prescribed in this part shall be covered by a certificate of conformity issued pursuant to Subpart F of this part.

(2) No manufacturer shall take any of the actions specified in section 203(a)(1) of the Act with respect to any gasoline fueled or diesel powered heavy duty vehicle which uses an engine which has not been certified as meeting applicable standards. Such manufacturer shall provide to the Secretary prior to the beginning of each model year a statement signed by an authorized representative which includes the following information:

(i) A description of the vehicles which will be produced subject to this section;

(ii) Identification of the engines used in the vehicles;

(iii) Projected sales data on each vehicle-engine combination;

(iv) A statement that the engines have not been modified by the vehicle manufacturer or a detailed specification of any changes which may have been made.

(b) (1) Any system installed on or incorporated in a new motor vehicle or new motor vehicle engine to enable such vehicle to conform to standards imposed by this part:

(i) Shall not in its operation or function cause the emission into the ambient air of any noxious or toxic substance that would not be emitted in the operation of such vehicle or engine without such system, except as specifically permitted by regulation; and

(ii) Shall not in its operation, function, or malfunction result in any unsafe condition endangering the motor vehicle, its occupants, or persons or property in close proximity to the vehicle.

(2) Every manufacturer of new motor vehicles or new motor vehicle engines subject to any of the standards imposed by this part shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicles or motor vehicle engines in accordance with good engineering practice to ascertain that such test vehicles or engines will meet the requirements of this section for the lifetime of the vehicle or engine as defined in § 85.92, § 85.113, or § 85.133, as appropriate.

§ 85.4 Labeling.

(a) (1) The manufacturer of any light duty motor vehicle subject to any of the standards prescribed in this part shall, at the time of manufacture, affix a permanent, legible label, of the type and in the manner described below, containing the information hereinafter provided, to all production models of such vehicles available for sale to the public and covered by a certificate of conformity under § 85.55(a).

(2) A plastic or metal label shall be welded, riveted, or otherwise permanently attached in a readily visible position in the engine compartment.

(3) The label shall be affixed by the vehicle manufacturer, who has been issued the certificate of conformity for such vehicle, in such a manner that it cannot be removed without destroying or defacing the label, and shall not be affixed to any equipment which is easily detached from such vehicle.

(4) The label shall contain the following information lettered in the English language in block letters and numerals, which shall be of a color that contrasts with the background of the label:

(i) The label heading: Vehicle Emission Control Information;

(ii) Full corporate name and trademark of manufacturer;

(iii) Engine displacement (in cubic inches) and engine family identification;

(iv) Engine tuneup specifications and adjustments, as recommended by the manufacturer, including idle speed, ignition timing, and idle air-fuel mixture setting and/or idle carbon monoxide setting. These specifications should indicate the proper transmission position during tuneup and what accessories (e.g., air-conditioner), if any, should be in operation;

(v) The statement: "This Vehicle Conforms to U.S. Dept. of H.E.W. Regulations Applicable to (insert current year) Model Year New Motor Vehicles."

(b) The manufacturer of any heavy duty gasoline fueled engine shall, at the time of manufacture, affix a permanent, legible plastic or metal label, containing the information hereinafter provided to all production models of such engines available for sale to the public, and covered by a certificate of conformity under § 85.55(a). The label shall be affixed at such a location that it will be readily accessible for inspection after the engine is installed in a vehicle and shall read as follows:

ENGINE EMISSION CERTIFICATION

This engine is, in all material respects, of substantially the same construction as test engines certified by the U.S. Department of Health, Education, and Welfare as conforming to Federal regulations pertaining to crankcase and exhaust emissions.

Engine family identification and engine displacement (in cubic inches) _____
Date of manufacture _____
(Month and year)
Name of manufacturer _____

(The information applicable to each engine is to be inserted on the appropriate line.)

(c) The manufacturer of any heavy duty diesel engine shall, at the time of manufacture, affix a permanent, legible plastic or metal label containing the information hereinafter provided to all production models of such engines available for sale to the public, and covered by a certificate of conformity under § 85.55(a). The label shall be affixed at such a location that it will be readily accessible for inspection after the engine is installed in a vehicle and shall read as follows:

ENGINE SMOKE EMISSION CERTIFICATION

This engine is, in all material respects, or substantially the same construction as test engines certified by the U.S. Department of Health, Education, and Welfare as conforming to Federal regulations pertaining to exhaust smoke emission.

Engine family identification and model _____
Date of manufacture _____
(Month and year)
Name of manufacturer _____

(The information applicable to each engine is to be inserted on the appropriate line.)

(d) The provisions of this section shall not prevent a manufacturer from also reciting on the label that such vehicle or engine conforms to any applicable State emission standards for new motor vehicles or new motor vehicle engines or any other information that such manufacturer deems necessary for, or useful to, the proper operation and satisfactory maintenance of the vehicle or engine.

§ 85.5 Submission of vehicle identification numbers.

(a) The manufacturer of any light duty motor vehicle covered by a certificate of conformity under § 85.55(a) shall, not later than 60 days after its manufacture, submit to the Secretary the vehicle identification number of such vehicle.

(b) The manufacturer of any heavy duty engine covered by a certificate of conformity under § 85.55(a) shall furnish to the Secretary, within 90 days after the close of any period covered by a certificate of conformity, a list of serial numbers of production engines manufactured in the period covered by the certificate of conformity.

(c) The requirements of this section may be waived with respect to any manufacturer who provides information satisfactory to the Secretary which will enable the Secretary to identify those vehicles or engines which are covered by a certificate of conformity.

§ 85.6 Production vehicles and engines.

(a) Any manufacturer obtaining certification under this part shall supply to the Secretary, upon his request, a reasonable number of production vehicles or engines selected by the Secretary which are representative of the engines, emission control systems, fuel systems, and transmissions offered and typical of production models available for sale under the certificate. These vehicles or engines shall be supplied for testing at such time and place and for such reasonable periods as the Secretary may require. Engines supplied under this paragraph may be

required to be mounted in chassis and appropriately equipped for operation on a chassis dynamometer.

(b) Any manufacturer obtaining certification under this part shall notify the Secretary, on a quarterly basis, of the number of vehicles of each engine family - engine displacement - exhaust emission control system-fuel system-transmission type-inertia weight class combination or the number of engines of each engine family-engine displacement-exhaust emission control system-fuel system combination produced for sale in the United States during the preceding quarter. This notification may be combined, as appropriate, with the notification required under § 85.5.

(c) All light duty vehicles covered by a certificate of conformity under § 85.55 (a) shall be adjusted by the manufacturer to the specifications detailed in § 85.4(a)(4)(iv).

§ 85.7 Test conditions.

All emission control systems installed on or incorporated in a new motor vehicle or new motor vehicle engine shall be functioning during all test procedures in this part.

§ 85.8 Special test procedures.

The Secretary may, on the basis of a written application therefor by a manufacturer, prescribe test procedures, other than those set forth in this part, for any motor vehicle or motor vehicle engine which he determines is not susceptible to satisfactory testing by the procedures set forth herein.

§ 85.9 Maintenance of records; submittal of information; right of entry.

(a) The manufacturer of any new motor vehicle or new motor vehicle engine subject to any of the standards prescribed in this part shall establish and maintain the following adequately organized and indexed records:

(1) Identification and description of all vehicles or engines for which testing is required under this part.

(2) A description of all emission control systems which are installed on or incorporated in each vehicle or engine.

(3) A description of the procedures used to test such vehicles or engines.

(4) Test data on each emission data vehicle or engine which will show its emissions at 0 and 4,000 miles or 0 and 125 hours, respectively.

(5) Test data on each durability vehicle or engine which will show the performance of the systems installed on or incorporated in the vehicle or engine during extended mileage or operation, as well as a record of all pertinent maintenance performed on the vehicle or engine.

(b) The manufacturer of any new motor vehicle or new motor vehicle engine subject to any of the standards prescribed in this part shall submit the following information to the Secretary:

(1) Copies of all communications with other manufacturers, assembly plants, distributors, dealers, and ultimate purchasers which include instructions or explanations regarding the use, repair, adjustment, maintenance, or testing of such vehicle or engine relevant to the control of crankcase, exhaust, or evaporative emissions.

(2) Warranty experience relevant to crankcase, exhaust, or evaporative emissions from such vehicle or engine.

(c) The manufacturer of any new motor vehicle or new motor vehicle engine subject to any of the standards prescribed in this part shall permit officers or employees duly designated by the Secretary, upon presenting appropriate credentials and a written notice to the manufacturer:

(1) To enter, at reasonable times, any premises used during the certification procedure for purposes of monitoring tests and mileage accumulation procedures, observing maintenance procedures, and verifiying correlation of measuring equipment, or

(2) To inspect, at reasonable times, records, files, and papers compiled by such manufacturer in accordance with paragraph (a) of this section.

A separate notice shall be given for each such inspection, but a notice shall not be required for each entry made during the period covered by the inspection. Each such inspection shall be commenced and completed with reasonable promptness.

Subpart B—Crankcase Emissions (Gasoline Fueled Vehicles and Engines)

§ 85.10 Applicability.

The provisions of this subpart are applicable to all new gasoline fueled light duty vehicles, except motorcycles, and heavy duty engines beginning with the 1972 model year for such vehicles and engines.

§ 85.11 Standard for crankcase emissions.

No crankcase emissions shall be discharged into the ambient atmosphere from any new motor vehicle or new motor vehicle engine subject to this subpart.

§ 85.12 Test procedures.

Every manufacturer of new motor vehicles or new motor vehicle engines subject to the standard prescribed in this subpart shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicles or motor vehicle engines in accordance with good engineering practice to ascertain that such test vehicles or engines, with proper maintenance, will meet the requirements of § 85.11 for a period not less than 100,000 miles or 3,000 hours, respectively. If, pursuant to § 85.55 (a), the Secretary issues a certificate of conformity for the class or classes of motor vehicles or motor vehicle engines represented by such test vehicles or engines, any new motor vehicle or motor vehicle engine which is in all material respects of substantially the same construction as such test vehicle or engine shall be deemed to be in conformity with the requirement of § 85.11.

Subpart C—Exhaust Emissions and Fuel Evaporative Emissions (Gasoline Fueled Light Duty Vehicles)

§ 85.20 Applicability.

The provisions of this subpart are applicable to new gasoline fueled light duty motor vehicles, except motorcycles, beginning with the model year specified therein.

§ 85.21 Standards for exhaust emissions.

(a) (1) Exhaust emissions from 1972, 1973, and 1974 model year vehicles shall not exceed:

(i) Hydrocarbons—2.9 grams per vehicle mile.

(ii) Carbon monoxide—37.0 grams per vehicle mile.

(2) Exhaust emissions from vehicles beginning with the 1975 model year shall not exceed:

(i) Hydrocarbons—0.5 gram per vehicle mile.

(ii) Carbon monoxide—11.0 grams per vehicle mile.

(b) The standards set forth in paragraph (a) of this section refer to the exhaust emitted over a driving schedule as set forth in the applicable sections of "Test Procedures for Vehicle Exhaust and Fuel Evaporative Emissions (Gasoline Fueled Light Duty Vehicles)" of this part and measured and calculated in accordance with those procedures.

§ 85.22 Standard for fuel evaporative emissions.

(a) Fuel evaporative emissions from vehicles beginning with the 1972 model year shall not exceed:

(1) Hydrocarbons—2 grams per test.

(b) The standard set forth in paragraph (a) of this section refers to a composite sample of the fuel evaporative emissions collected under the conditions set forth in the "Test Procedures for Vehicle Exhaust and Fuel Evaporative Emissions (Gasoline Fueled Light Duty Vehicles)" of this part and measured in accordance with those procedures.

§ 85.23 Test procedures.

Every manufacturer of new motor vehicles subject to the standards prescribed in this subpart shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicles in accordance with test procedures in Subpart H of this part to ascertain that such test vehicles meet the requirements of §§ 85.21 and 85.22, as applicable. If, pursuant to § 85.55(a), the Secretary issues a certificate of conformity for the class or classes of vehicles represented by such test vehicles, any new motor vehicle which is in all material respects of substantially the same construction as such test vehicles shall be deemed to be in conformity with the requirements of §§ 85.21 and 85.22, as applicable.

Subpart D—Exhaust Emissions (Gasoline Fueled Heavy Duty Engines)

§ 85.30 Applicability.

The provisions of this subpart are applicable to new gasoline fueled heavy

duty engines beginning with the 1972 model year.

§ 85.31 Standards for exhaust emissions.

(a) Exhaust emissions from new gasoline fueled heavy duty engines shall not exceed:

(1) Hydrocarbons—275 p.p.m.

(2) Carbon monoxide—1.5 percent by volume.

(b) The standards set forth in paragraph (a) of this section refer to a composite sample representing the operating cycles set forth in the applicable sections of "Test Procedures for Engine Exhaust Emissions (Gasoline Fueled Heavy Duty Engines)" of this part and measured in accordance with those procedures.

§ 85.32 Test procedures.

Every manufacturer of new motor vehicle engines subject to the standards prescribed in this subpart shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with test procedures prescribed in Subpart I of this part to ascertain that such test engines meet the requirements of § 85.31. If, pursuant to § 85.55(a), the Secretary issues a certificate of conformity for the class or classes of motor vehicle engines represented by such test engines, any new motor vehicle engine which is in all material respects of substantially the same construction as such test engines shall be deemed to be in conformity with the requirements of § 85.31.

Subpart E—Exhaust Emissions (Heavy Duty Diesel Engines)

§ 85.40 Applicability.

The provisions of this subpart are applicable to new heavy duty diesel engines beginning with the 1972 model year.

§ 85.41 Standards for exhaust smoke.

(a) The opacity of smoke emissions from new diesel engines subject to this subpart shall not exceed:

(1) 40 percent during the engine acceleration mode.

(2) 20 percent during the engine lugging mode.

(b) The standards set forth in paragraph (a) of this section refer to exhaust smoke emissions generated under the conditions set forth in the "Test Procedures for Engine Exhaust Emissions (Heavy Duty Diesel Engines)" of this part and measured and calculated in accordance with those procedures.

§ 85.42 Test procedures.

Every manufacturer of new motor vehicle engines subject to the standards prescribed in this subpart shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with test procedures prescribed in Subpart J of this part, to ascertain that such test engines meet the requirements of §85.41. If, pursuant to §85.55(a), the Secretary issues a certificate of conformity for the class or classes of motor vehicle engines represented by such test engines, any motor vehicle engine which is in all material respects of substantially the same construction as such test engines shall be deemed to be in conformity with the requirements of § 85.41.

Subpart F—Certification of Motor Vehicles and Motor Vehicle Engines

§ 85.50 Applicability.

The provisions of this subpart are applicable to new motor vehicles and new motor vehicle engines subject to the standards prescribed in this part. As used in this subpart, the term "vehicle" and "test vehicle" shall include engines and test engines, respectively.

§ 85.51 Application for certification.

(a) An application for a certificate of conformity to the regulations applicable to any new motor vehicle shall be made to the Secretary by the manufacturer.

(b) The application shall be in writing, signed by an authorized representative of the manufacturer, and shall include the following:

(1) Identification and description of the vehicles covered by the application and a description of their emission control systems.

(2) Projected U.S. sales data sufficient to enable the Secretary to select a test fleet representative of the vehicles for which certification is requested.

(3) A description of the test equipment and fuel proposed to be used.

(4) A description of the proposed mileage accumulation procedure for durability testing.

(5) A statement of recommended maintenance and procedures necessary to assure that the vehicles covered by a certificate of conformity, in operation conform to the regulations, and a description of the program for training of personnel for such maintenance, and the equipment required.

(6) At the option of the manufacturer, the proposed composition of the emission data and durability data test fleet.

§ 85.52 Approval of procedure and equipment; test fleet selections.

Based upon the information provided in the application for certification, and any other information the Secretary may require, the Secretary will approve or disapprove in whole or in part the mileage accumulation procedure and equipment and fuel proposed by the manufacturer, and notify him in writing of such determination. Where any part of a proposal is disapproved, such notification will specify the reasons for disapproval. The Secretary will select a test fleet in accordance with § 85.89, § 89.110, or § 85.130, as appropriate.

§ 85.53 Required data.

The manufacturer shall perform the tests required by the applicable test procedures, and submit to the Secretary the following information:

(a) Durability data on such vehicles tested in accordance with the applicable test procedures of this part, and in such numbers as therein specified, which will show the performance of the systems installed on or incorporated in the vehicle for extended mileage or operation, as well as a record of all pertinent maintenance performed on the test vehicles.

(b) Emission data on such vehicles tested in accordance with the applicable emission test procedures of this part and in such numbers as therein specified, which will show their emissions after 4,000 miles or 125 hours of operation (as appropriate).

(c) A description of tests performed to ascertain compliance with the general standards in § 85.3 and the data derived from such tests.

(d) A statement that the test vehicles with respect to which data are submitted have been tested in accordance with the applicable test procedures, that they meet the requirement of such tests, and that, on the basis of such tests, they conform to the requirements of the regulations in this part. If such statements cannot be made with respect to any vehicle tested, the vehicle shall be identified, and all pertinent test data relating thereto shall be supplied.

§ 85.54 Testing by the Secretary.

(a) The Secretary may require that any one or more of the test vehicles be submitted to him, at such place or places as he may designate, for the purpose of conducting emissions tests. The Secretary may specify that he will conduct such testing at the manufacturer's facility, in which case instrumentation and equipment specified by the Secretary shall be made available by the manufacturer for test operations. Any testing conducted at a manufacturer's facility pursuant to this paragraph shall be scheduled by the manufacturer as promptly as possible.

(b) (1) Whenever the Secretary conducts a test on a test vehicle, the results of that test shall comprise the official data for the vehicle at that prescribed test point.

(2) Whenever the Secretary does not conduct a test on a test vehicle at a test point, the manufacturer's test date will be accepted as the official data for that test point: *Provided*, That if the Secretary makes a determination, based on testing under paragraph (a) of this section, that there is a lack of correlation between the manufacturer's test equipment and the test equipment used by the Secretary, no manufacturer's test data will be accepted for purposes of certification until the reasons for the lack of correlation are determined and the validity of the data is established by the manufacturer.

(3) If the Secretary determines that the test data developed under paragraph (a) of this section would cause a vehicle to fail due to excessive 4,000-mile or 125-hour emissions or excessive deterioration, then the following procedure shall be observed:

(i) The manufacturer may request a retest. Before the retest, the vehicle may be adjusted to manufacturer's specifications, and parts may be replaced in ac-

cordance with § 85.90, § 85.111, or § 85.131, as appropriate. All work on the vehicle shall be done at such location and under such conditions as the Secretary may prescribe.

(ii) The vehicle will be retested by the Secretary and the results of this test shall comprise the official data for that prescribed test point.

(4) If sufficient durability data is not available, at the time of any emission test conducted under paragraph (a) of this section, to enable the Secretary to determine whether a test vehicle would fail, the manufacturer may request a retest in accordance with the provisions of subparagraph (3) (i) and (ii) of this paragraph. If the manufacturer does not promptly make such request, he shall be deemed to have waived the right to a retest. A request for retest must be made before the manufacturer removes the vehicle from the test premises.

§ 85.55 Certification.

(a) (1) If, after a review of the test reports and data submitted by the manufacturer and data derived from any additional testing conducted pursuant to § 85.54, the Secretary determines that a test vehicle(s) conforms to the regulations of this part, he will issue a certificate of conformity with respect to such vehicle(s).

(2) Such certificate will be issued for such period not less than 1 year as the Secretary may determine and upon such terms as he may deem necessary to assure that any new motor vehicle covered by the certificate will meet the requirements of these regulations relating to durability and performance.

(b) (1) The Secretary will determine whether a vehicle covered by the application complies with applicable standards by observing the following relationships:

(i) A test vehicle selected under § 85.89 (b) (2), § 85.110(b) (2), or § 85.130(b) (2), as appropriate, shall represent all vehicles in the same engine family of the same engine displacement-exhaust emission control system-evaporative emission control system combination.

(ii) A test vehicle selected under § 85.89(b) (3) or § 85.110(b) (3), as appropriate, shall represent all vehicles in the same engine family of the same engine displacement-exhaust emission control system-transmission type-fuel system combination.

(iii) A test vehicle selected under § 85.89(c) (1), § 85.110(c) (1), or § 85.130 (c) (1), as appropriate, shall represent all vehicles of the same engine-system combination.

(2) The Secretary will proceed as in paragraph (a) of this section with respect to the vehicles belonging to an engine family all of which comply with applicable standards.

(3) If, after a review of the test reports and data submitted by the manufacturer and data derived from any additional testing conducted pursuant to § 85.54, the Secretary determines that one or more test vehicles of the certification test fleet do not meet applicable standards, he will notify the manufacturer in writing, setting forth the basis for his determination. Within 15 days following receipt of the notification, the manufacturer may request a hearing on the Secretary's determination. The request shall be in writing, signed by an authorized representative of the manufacturer and shall include a statement specifying the manufacturer's objections to the Secretary's determination, and data in support of such objections. If, after a review of the request and supporting data, the Secretary finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with subpart G with respect to such issue.

(4) The manufacturer may, at his option, proceed with any of the following alternatives with respect to any engine family represented by a test vehicle(s) determined not in compliance with applicable standards:

(i) Request a hearing under subpart G, or

(ii) Delete from the application for certification the vehicles represented by the failing test vehicle. (Vehicles so deleted may be included in a later request for certification under § 85.57.) The Secretary will then select in place of each failing vehicle an alternate vehicle chosen in accordance with selection criteria employed in selecting the vehicle that failed, or

(iii) Modify the test vehicle and demonstrate by testing that it meets applicable standards. Another vehicle which is in all material respects the same as the first vehicle, as modified, shall then be operated and tested in accordance with applicable test procedures.

(5) If the manufacturer does not request a hearing or present the required data under subparagraph (4) of this paragraph, the Secretary will deny certification.

§ 85.56 Separate certification.

Where possible a manufacturer should include in a single application for certification all vehicles for which certification is required. A manufacturer may, however, choose to apply separately for certification of part of his product line. The selection of test vehicles and the computation of test results will be determined separately for each application.

§ 85.57 Addition of a vehicle after certification.

(a) If a manufacturer proposes to add to his product line a vehicle of the same engine-system combination as vehicles previously certified but which was not described in the application for certification when the test vehicle(s) representing other vehicles of that combination was certified, he shall notify the Secretary in advance of this addition. This notification shall include a full description of the vehicle proposed to be added.

(b) The Secretary may require the manufacturer to perform such tests on the test vehicle(s) representing the vehicle proposed to be added which would have been required if the vehicle had been included in the original application for certification.

(c) If, after a review of the test reports and data submitted by the manufacturer, and data derived from any testing conducted under § 85.54, the Secretary determines that the test vehicle(s) meets all applicable standards, the appropriate certificate will be amended accordingly. If the Secretary determines that the test vehicle(s) does not meet applicable standards, he will proceed under § 85.55(b).

§ 85.58 Changes to a vehicle covered by certification.

(a) The manufacturer shall notify the Secretary in advance of any intended change in production vehicles in respect to any of the parameters listed in § 85.89 (a) (3), § 85.89(b) (3), or § 85.110(b) (3). Such notification shall contain a full description of the change intended to be made.

(b) Based upon the description of the intended change, and data derived from such testing as the Secretary may require or conduct, the Secretary will determine whether the vehicle, as modified, would still be covered by the certificate of conformity then in effect.

(c) If the Secretary determines that the outstanding certificate would cover the modified vehicles, he will notify the manufacturer in writing and the manufacturer may proceed with the intended change. If the Secretary determines that the modified vehicles would not be covered by the certificate then in effect, then the modified vehicles shall be treated as additions to the product line subject to § 85.57.

Subpart G—Hearings on Certification

§ 85.60 Hearing.

(a) After granting a request for a hearing under § 85.55, the Secretary will designate a Presiding Officer for the hearing.

(b) The General Counsel will represent the Department of Health, Education, and Welfare in any hearing under this subpart.

(c) If a time and place for the hearing have not been fixed by the Secretary under § 85.55, the hearing shall be held as soon as practicable at a time and place fixed by the Secretary or by the Presiding Officer.

§ 85.61 Hearing file.

(a) Upon his appointment pursuant to § 85.60, the Presiding Officer will establish a hearing file. The file shall consist of the notice issued by the Secretary under § 85.55, together with any accompanying material, the request for a hearing and the supporting data submitted therewith and all documents relating to the request for certification, including the application for certification and all documents submitted therewith, and correspondence and other data material to the hearing.

(b) The appeal file will be available for inspection by the applicant at the office of the Presiding Officer.

§ 85.62 Representation.

An applicant may appear in person, or may be represented by counsel or by any other duly authorized representative.

§ 85.63 Prehearing conference.

(a) The Presiding Officer upon the request of any party, or in his discretion, may arrange for a prehearing conference at a time and place specified by him to consider the following:

(1) Simplification of the issues;

(2) Stipulations, admissions of fact, and the introduction of documents;

(3) Limitation of the number of expert witnesses;

(4) Possibility of agreement disposing of all or any of the issues in dispute;

(5) Such other matters as may aid in the disposition of the hearing, including such additional tests as may be agreed upon by the parties.

(b) The results of the conference shall be reduced to writing by the Presiding Officer and made part of the record.

§ 85.64 Conduct of hearings.

(a) Hearings shall be conducted by the Presiding Officer in an informal but orderly and expeditious manner. The parties may offer oral or written evidence, subject to the exclusion by the Presiding Officer of irrelevant, immaterial, and repetitious evidence.

(b) Witnesses will not be required to testify under oath. However, the Presiding Officer shall call to the attention of witnesses that their statements may be subject to the provisions of title 18 U.S.C. 1001 which imposes penalties for knowingly making false statements or representations, or using false documents in any matter within the jurisdiction of any department or agency of the United States.

(c) Any witnesses may be examined or cross-examined by the Presiding Officer, the parties, or their representatives.

(d) Hearings shall be reported verbatim. Copies of transcripts of proceedings may be purchased by the applicant from the reporter.

(e) All written statements, charts, tabulations, and similar data offered in evidence at the hearing shall, upon a showing satisfactory to the Presiding Officer of their authenticity, relevancy, and materiality, be received in evidence and shall constitute a part of the record.

(f) Oral argument may be permitted in the discretion of the Presiding Officer and shall be reported as part of the record unless otherwise ordered by him.

§ 85.65 Initial and final decisions.

(a) The Presiding Officer shall make an initial decision which shall include written findings and conclusions and the reasons or basis therefor on all the material issues of fact, law or discretion presented on the record. The findings, conclusions, and written decision shall be provided to the parties and made a part of the record. The initial decision shall become the decision of the Secretary without further proceedings unless there is an appeal to the Secretary or motion for review by the Secretary within 20 days of the date the initial decision was filed.

(b) On appeal from or review of the initial decision the Secretary shall have all the powers which he would have in making the initial decision including the discretion to require or allow briefs, oral argument, the taking of additional evidence or the remanding to the Presiding Officer for additional proceedings. The decision by the Secretary shall include written findings and conclusions and the reasons or basis therefor on all the material issues of fact, law, or discretion presented on the appeal or considered in the review.

Subpart H—Test Procedures for Vehicle Exhaust and Fuel Evaporative Emissions (Gasoline Fueled Light Duty Vehicles)

§ 85.70 Introduction.

The procedures described in this subpart will be the test program to determine the conformity of gasoline fueled light duty vehicles with the applicable standards set forth in this part.

(a) The test consists of prescribed sequences of fueling, parking, and operating conditions. The exhaust gases generated during vehicle operation are diluted with air and sample continuously for subsequent analysis of specific components by prescribed analytical techniques. The fuel evaporative emissions are collected for subsequent weighing during both vehicle parking and operating events. The test applies to vehicles equipped with catalytic or direct-flame afterburners, induction system modifications, or other systems or to uncontrolled vehicles and engines.

(b) The exhaust emission test is designed to determine hydrocarbon and carbon monoxide mass emissions while simulating an average trip in an urban area of 7.5 miles from a cold start. The test consists of engine startup and vehicle operation on a chassis dynamometer through a specified driving schedule, as described in appendix A to this part. A proportional part of the diluted exhaust emissions is collected continuously, for subsequent analysis, using a constant volume (variable dilution) sampler.

(c) The fuel evaporative emission test is designed to determine fuel hydrocarbon evaporative emissions to the atmosphere as a consequence of urban driving, and diurnal temperature fluctuations during parking. It is associated with a series of events representative of a motor vehicle's operation, which results in fuel vapor losses directly from the fuel tank and carburetor. The test procedure is specifically aimed at collecting and weighing:

(1) Diurnal breathing losses from the fuel tank and other parts of the fuel system when the fuel tank is subjected to a temperature increase representative of the diurnal range;

(2) Running losses from the fuel tank and carburetor resulting from a simulated trip from a cold start;

(3) Hot soak losses from the fuel tank and carburetor which result when the vehicle is parked and the hot engine is turned off. The average trip is simulated by operating the vehicle on a chassis dynomometer. Activated carbon traps are employed in collecting the vaporized fuel.

§ 85.71 Gasoline fuel specifications.

(a) Fuel having the following specifications, or substantially equivalent specifications approved by the Secretary, shall be used in exhaust and evaporative emission testing.

Item	ASTM designation	Specifications
Octane, Research, min	D 1656	100
Pb. (organic), gm./U.S. gal	D 526	3.1–3.3
Distillation range	D 86	
IBP, ° F		75–95
10 percent point, °F		120–135
50 percent point, °F		200–230
90 percent point, °F		300–325
EP, °F. (max.)		415
Sulfur, wt. percent, max	D 1266	0.10
Phosphorus, theory		0.0
RVP,[1] lb	D 323	8.7–9.2
Hydrocarbon composition	D 1319	
Olefins, percent, max		10
Aromatics, percent, max		35
Saturates		Remainder

[1] For testing which is unrelated to fuel evaporative emission control, the specified range is: 8.0–9.2.

(b) Fuel having the following specifications, or substantially equivalent specifications approved by the Secretary, shall be used in mileage accumulation. The octane rating of the fuel used shall be in the range recommended by the vehicle or engine manufacturer. The Reid Vapor Pressure of the fuel used shall be characteristic of the seasonal motor fuel.

Item	ASTM Designation	Regular	Premium
Pb. (organic), gm./U.S. gal	D 526	2.1–3.2	2.1–3.2
Sulfur, wt. percent	D 1266	0.02–0.10	0.2–0.10
Hydrocarbon composition	D 1319		
Olefins, percent, max		30	15
Aromatics, percent, max		40	40
Saturates		Remainder	Remainder

(c) The specifications of the fuel to be used under paragraph (b) of this section shall be reported in accordance with § 85.51(b)(3).

§ 85.72 Vehicle and engine preparation (fuel evaporative emissions).

(a) (1) Apply appropriate leak-proof fittings to all fuel system external vents to permit collection of effluent vapors from these vents during the course of the prescribed tests. Since the prescribed test requires the temporary plugging of the inlet pipe to the air cleaner, it will be necessary to install a probe for collecting the normal effluents from this source. Where antisurge/vent filler caps are employed on the fuel tank, plug off the normal vent if it does not conveniently lend itself to the collection of

vapors which emanate from it, and introduce a separate vent, with appropriate fitting, on the cap. Where the fuel tank vent line terminus is inaccessible, sever the line at a convenient point near the fuel tank and install the collection system in a closed circuit assembly with the severed ends. All fittings shall terminate in 5/16-inch ID tube sections for ready connection to the collection systems and shall be designed for minimum dead space.

(2) The design and installation of the necessary fittings shall not disturb the normal function of the fuel system components or the normal pressure relationships in the system.

(b) (1) Inspect the fuel system carefully to insure the absence of any leaks to the atmosphere of either liquid or vapor which might affect the accuracy of the test or the performance of the control system. Corrective action, if any, shall be reported with the test results under § 85.53.

(2) Care should be exercised, in the application of any pressure tests, neither to purge nor load the evaporative emission control system.

(c) Prepare fuel tank for recording the temperature of the prescribed test fuel at its approximate midvolume.

(d) Provide additional fittings and adapters, as required to accommodate a fuel drain at the lowest point possible in the tank as installed on the vehicle.

§ 85.73 Vehicle preconditioning (fuel evaporative emissions).

Vehicle to be tested for compliance with the fuel evaporative emissions standard of this part shall be preconditioned as follows:

(a) The test vehicle shall be operated under the conditions prescribed for mileage accumulation, § 85.91, for 1 hour immediately prior to the operations prescribed below.

(b) The fuel tank shall be drained and specified test fuel (§ 85.71(a)) added. The evaporative emission control system or device shall not be abnormally purged or loaded as a result of draining or fueling the tank.

(c) The test vehicle shall be placed on the dynamometer and operated over a simulated trip, according to the applicable requirements and procedures of §§ 85.75–85.80 except that the engine need not be cold when starting the run on the dynamometer operation. During the run the ambient temperature shall be between 68° F. and 86° F.

(d) The engine and cooling fan shall be stopped upon completion of the dynamometer operation and the vehicle permitted to soak either on or off the dynamometer stand at an ambient temperature between 76° F. and 86° F. for a period of not less than 1 hour prior to the soak period prescribed in § 85.74 (a)(1).

§ 85.74 Evaporative emission collection procedure.

The standard test procedure consists of three parts described below which shall be performed in sequence and without any interruption in the test conditions prescribed.

(a) *Diurnal breathing loss test.* (1) The test vehicle shall be allowed to "soak" in an area where the ambient temperature is maintained between 60° F. and 86° F. for a period of not less than 10 hours. (The vehicle preparation requirements of § 85.72 may be performed during this period.) It shall than be transferred to a soak area where the ambient temperature is maintained between 76° F. and 86° F. Upon admittance to the 76° F–86° F. soak area, the prescribed fuel tank thermocouple shall be connected to the recorder and the fuel and ambient temperatures recorded at a chart speed of approximately 12 inches per hour (or equivalent record).

(2) The fuel tank of the prepared test vehicle, preconditioned according to §85.73, shall be drained and recharged with the specified test fuel, §85.71(a) to the prescribed "tank fuel volume," defined in § 85.1. The temperature of the fuel following the charge to the tank shall be 60° F.±2° F. Care should be exercised against abnormal loading of the evaporative emission control system or device as a result of fueling the tank.

(3) Immediately following the fuel charge to the tank, the exhaust pipe(s) and inlet pipe to the air cleaner shall be plugged and the prescribed vapor collection systems installed on all fuel stystem external vents. Multiple vents may be connected to a single collection trap provided that, where there is more than one external vent on a fuel system distinguishing between carburetor and tank vapors, separate collection systems shall be employed to trap the vapors from the separate sources. Every precaution shall be taken to minimize the lengths of the collection tubing employed and to avoid sharp bends across the entire system.

(4) Artificial means shall be employed to heat the fuel in the tank to 84° F. ±2° F. The prescribed temperature of the fuel shall be achieved over a period of 60 minutes±10 minutes using a constant rate of heat input. After a minimum of 1 hour, following admittance to the 76° F.–86° F. soak area, the vehicle shall be moved onto the dynamometer stand for the subsequent part of the test. The fuel tank thermocouple may be temporarily disconnected to permit moving the test vehicle. Plugs shall be removed from the exhaust pipe(s) and inlet pipe to the air cleaner.

(b) *Running loss test.* (1) The test vehicle shall be placed on the dynamometer with the hood up and the cooling fan positioned between 8" and 12" from the grill and directed squarely at the radiator. (Exception: air cooled engines.) The ambient air temperature shall be maintained between 68° F.–86° F. and recorded, together with the fuel temperature, at a chart speed of approximately 12 inches per hour (or equivalent record).

(2) Where the only external vent(s) is located in the immediate vicinity of the carburetor air horn, such that any "running loss" emissions would be inducted into the engine, there is no requirement to collect any vapor losses during this part of the test and the vapor-loss measurement system shall be temporarily disconnected and clamped.

(3) The vehicle shall be operated on the dynamometer according to the requirements and procedures of §§ 85.75–85.85. The engine and fan shall be turned off upon completion of the dynamometer run and the exhaust and air cleaner inlet pipes shall be replugged.

(4) Any vapor collection systems employed during this part of the test shall be left intact for their continued use during the following part. Any part of the vapor collection system disconnected during this phase of the test shall be reconnected for the following phase.

(c) *Hot soak test.* Upon completion of the dynamometer run, the test vehicle shall be permitted to soak with hood down for a period of 1 hour at an ambient temperature between 76° F. and 86° F. This operation completes the test. The traps are disconnected and weighed according to § 85.82.

§ 85.75 Dynamometer driving schedule.

(a) The dynamometer driving schedule to be followed consists of a nonrepetitive series of idle, acceleration, cruise, and deceleration modes of various time sequences and rates. The driving schedule is defined by a smooth transition through the speed vs. time relationships listed in appendix A. The time sequence begins upon starting the vehicle according to the startup procedure described in § 85.80.

(b) The following equipment shall be used for dynamometer tests:

(1) Chassis dynamometer-equipped with power absorption unit and flywheels.

(2) Cooling fan—a fixed-speed fan shall be used. It shall have sufficient capacity to maintain engine cooling during sustained operation on the dynamometer and its air moving capacity shall not exceed 5,300 c.f.m.

§ 85.76 Dynamometer procedure.

(a) The vehicle shall be tested from a cold start. Engine startup and operation over the driving schedule make a complete test run. Exhaust emissions are diluted with air to a constant volume and a portion is sampled continuously during the entire test run. The composite sample, collected in a bag, is analyzed for hydrocarbon and carbon monoxide. A parallel sample of the dilution air is similarly analyzed.

(b) Special considerations:

(1) On rolls less than 20 inches in diameter, the drive wheel tires shall be inflated to 45 p.s.i.g. in order to prevent tire damage.

(2) The vehicle shall be nearly level when tested in order to prevent abnormal fuel distribution.

(3) The cooling fan shall be positioned between 8 and 12 inches from the grill and directed squarely at the radiator (exception: air-cooled engines) and the dynamometer operation shall be carried out with the hood up.

(4) Flywheels giving equivalent inertia as shown in the following table shall be used. Flywheels giving heavier inertia may be used.

Loaded vehicle weight, lbs.:	*Equivalent inertia weight, lbs.*
Up to 1,625	1,500
1,626 to 1,875	1,750
1,876 to 2,125	2,000
2,126 to 2,375	2,250
2,376 to 2,625	2,500
2,626 to 2,875	2,750
2,876 to 3,250	3,000
3,251 to 3,750	3,500
3,751 to 4,250	4,000
4,251 to 4,750	4,500
4,751 to 5,250	5,000
5,251 to 6,000	5,500

(c) The power absorption unit shall be adjusted to reproduce road load at 50 m.p.h. true speed.

(1) The proper horsepower setting for a particular vehicle dynamometer combination is predetermined by:

(i) Measuring the absolute manifold vacuum of a representative vehicle, of the same equivalent inertia weight class, when operated on a level road under balanced wind conditions at a true speed of 50 m.p.h., and

(ii) Noting the dynamometer indicated road load horsepower setting required to reproduce that manifold vacuum, when the same vehicle is operated on the dynamometer at a true speed of 50 m.p.h.

(iii) The actual road load horsepower shall be determined according to the procedure outlined in appendix B and reported with the test results.

(2) Where it is expected that more than 33 percent of the vehicles in an engine family will be equipped with air conditioning, an additional 10 percent of the actual road load horsepower shall be added to the indicated horsepower for testing all test vehicles representing such engine family.

(d) Practice runs over the prescribed driving schedule may be performed to find the minimum throttle action to maintain the proper speed-time relationship.

(e) The vehicle speed (m.p.h.) as measured from the dynamometer rolls shall be used for all conditions. A speed vs. time recording, as evidence of dynamometer test validity, shall be supplied on request of the Secretary.

§ 85.77 Three-speed manual transmissions.

(a) All test conditions except as noted shall be run in highest gear.

(b) Cars equipped with free wheeling or overdrive units shall be tested with this unit (free wheeling or overdrive) locked out of operation.

(c) Idle shall be run with transmission in gear and with clutch disengaged (except first idle; see § 85.80).

(d) The vehicle shall be driven with minimum throttle movement to maintain the desired speed.

(e) Acceleration modes shall be driven smoothly with the shift speeds as recommended by the manufacturer in the owner's operating manual. If the owner's manual does not recommend shift speeds, the vehicle shall be shifted from first to second gear at 15 m.p.h. and from second to third gear at 25 m.p.h. Each shift should be accomplished rapidly to minimize closed-throttle time. If the vehicle cannot accelerate at the specified rates, the vehicle shall be accelerated at WOT until the vehicle speed reaches the speed at which it should be at that time during the test.

(f) The deceleration modes shall be run with clutch engaged and without shifting gears from the previous mode, using brakes or throttle as necessary to maintain the desired speed. For those modes which decelerate to zero, the clutch shall be depressed when the speed drops below 10 m.p.h. or when engine stalling is imminent.

(g) Downshifting is allowed at the beginning of or during a power mode if recommended by the manufacturer in the owner's operating manual or if the engine obviously is lugging.

§ 85.78 Four-speed and five-speed manual transmissions.

(a) Use the same procedure as for three-speed manual transmissions for shifting from first to second gear and from second to third gear. If the owner's operating manual does not recommend shift speeds, the vehicle shall be shifted from third to fourth gear at 40 m.p.h. Do not use fifth gear.

(b) If transmission ratio in first gear exceeds 5 : 1, follow the procedure for three- or four-speed manual transmission vehicles as if the first gear did not exist.

§ 85.79 Automatic transmissions.

(a) All test conditions shall be run with the transmission in "Drive" (highest gear).

(b) Idle modes shall be run with the transmission in "Drive" and the wheels braked (except first idle; see § 85.80).

(c) The vehicle shall be driven with minimum throttle movement to maintain the desired speed.

(d) Acceleration modes shall be driven smoothly allowing the transmission to shift automatically through the normal sequence of gears. If the vehicle cannot accelerate at the specified rates, the vehicle shall be accelerated at WOT until the vehicle speed reaches the speed at which it should be at that time during the driving schedule.

(e) The deceleration modes shall be run in gear using brakes or throttle as necessary to maintain the desired speed.

§ 85.80 Engine starting and restarting.

(a) The engine shall be started according to the manufacturer's recommended starting procedures including choke setting. The initial 20-second idle period shall begin when the engine starts.

(b) Choke operation:

(1) Vehicles equipped with automatic chokes shall be operated according to the manufacturer's operating or owner's manual including "kick-down" from cold fast idle. If choke "kick-down" time is not specified, it shall be performed immediately before the transmission is placed in gear. If necessary, braking may be employed to keep the drive wheels from turning.

(2) Vehicles equipped with manual chokes shall be operated according to the manufacturer's operating or owner's manual. If not specified, the choke shall be operated to maintain engine idle at 1,100±50 r.p.m. during the initial idle period and used where necessary during the remainder of the test to keep the engine running.

(c) The operator may use more choke, more throttle, etc., where necessary to keep the engine running.

(d) If the vehicle does not start after 10 seconds of cranking, cranking shall cease and the reason for failure to start determined. The revolution counter on the constant volume sampler (see § 85.85, Dynamometer test runs) shall be turned off and the sample solenoid valves placed in the "dump" position during this diagnostic period. If failure to start is an operational error, the vehicle shall be rescheduled for testing from a cold start. If failure to start is caused by vehicle malfunction, corrective action of less than 30 minutes duration may be taken and the test continued. If corrective action is unsuccessful in 30 minutes, the test shall be aborted. If the test is continued, the sampling system shall be reactivated at the same time cranking is started. When the engine is operating satisfactorily the driving schedule timing sequence shall begin. In all cases in which failure to start is caused by vehicle malfunction and the vehicle cannot be restarted the test shall be considered a valid failed test. The reason for the malfunction (if determined) and the corrective action taken shall be reported with the test results.

(e) If the engine "false starts", the operator shall repeat the recommended starting procedure (such as resetting the choke, etc.).

(f) Stalling:

(1) If the engine stalls during an idle period, the engine shall be restarted and the test continued. If the engine cannot be started soon enough to allow the vehicle to follow the next acceleration as prescribed, the driving schedule indicator shall be stopped. When the vehicle restarts the driving schedule indicator shall be reactivated.

(2) If the engine stalls during some operating mode other than idle, the driving schedule indicator shall be stopped, the vehicle restarted, accelerated to the speed required at that point in the driving schedule and the test continued.

(3) If the vehicle will not restart within 1 minute, the test shall be aborted and considered a valid failed test.

* * * * *

§ 85.82 Sampling and analytical system (fuel evaporative emissions).

(a) *Schematic drawings.* (1) The following figures (Figures 2, 3, and 4) are flow diagrams of typical evaporative loss collection applications.

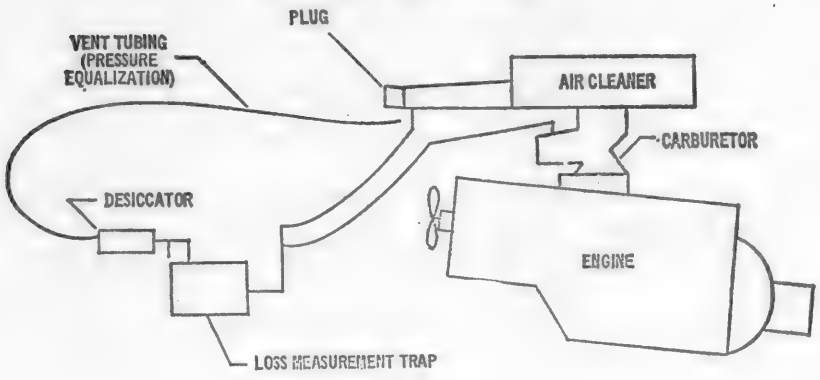

Figure 2. Typical carburetor evaporative loss collection arrangement (schematic).

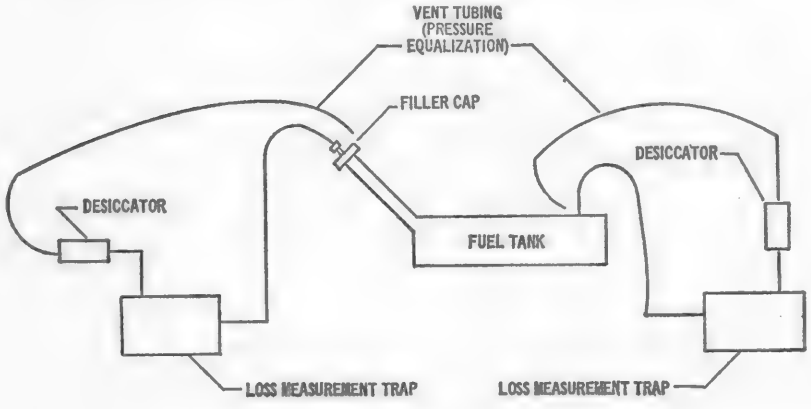

Figure 3. Typical fuel tank evaporative loss collection arrangement (schematic).

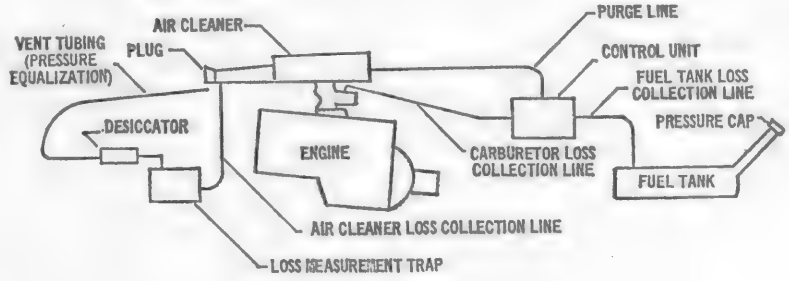

Figure 4. Typical fuel evaporative loss collection arrangement for vehicle equipped with evaporative emission control system (schematic).

(2) Figure 2 represents an arrangement for collecting losses which emanate from the carburetor. Figure 3 depicts the means for separately collecting the vapors which emanate from the fuel tank vent line and filler cap. Figure 4 shows an arrangement for collecting the losses from a closed fuel system, vented to the atmosphere solely through the air cleaner, as might be the case with certain fuel evaporative emission control devices.

(3) Schematic drawings of arrangements to be employed shall be submitted in accordance with § 85.51(b)(3).

(b) *Collection equipment.* The following equipment shall be used for this collection of fuel evaporative emissions. (Item quantities are determined by individual test needs.)

(1) *Activated carbon trap.* See Figure 5 for specifications of one design; other configurations may be used: *Provided,* That they give demonstrably equivalent results.

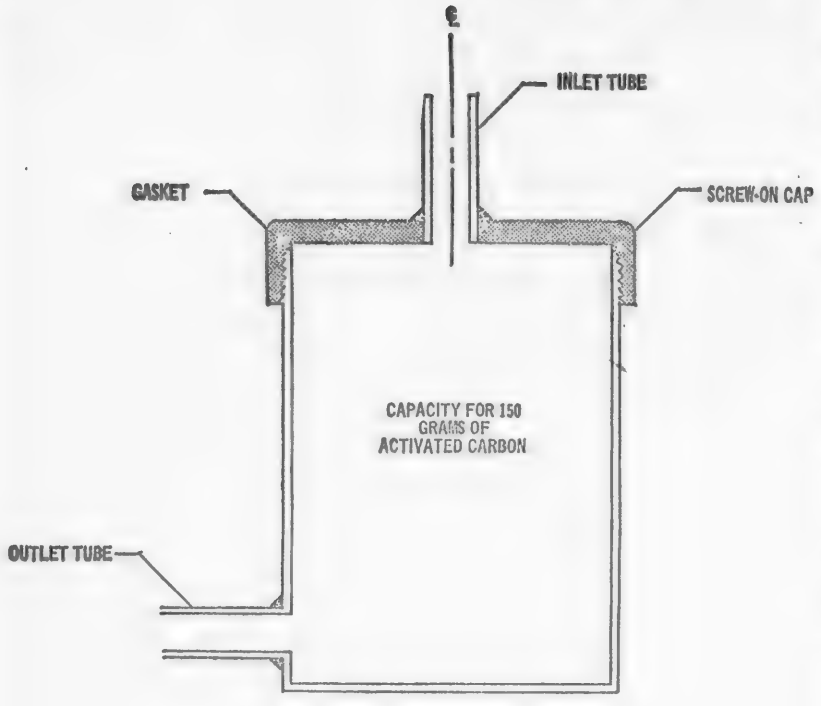

Figure 5. Typical activated carbon trap (schematic).

(i) Canister—300±25 ml., cylindrical container having a length to diameter ratio of 1.4±0.1. An inlet tube, $\frac{1}{8}$ inch ID and 1 inch long is sealed into the top of the canister, at its geometric center. A similar outlet tube is sealed into the wall $\frac{1}{4}$ inch from the bottom of the canister. The canister is designed to withstand an air pressure of 2 p.s.i., when sealed, without evidence of leaking when immersed in water for 30 seconds.

(ii) Activated carbon—meeting the following specifications:

Surface area, min. (N_2 BET method).[1]	1,000 square meters per gram.
Adsorption capacity, min. (carbon tetrachloride).	60 percent, by weight.
Volatile material including adsorbed water vapor.	None.

Screen analysis size:	Percent
Less than 1.4 mm	0
1.7–2.4 mm	90–100
More than 3.0 mm	0

[1] Brunauer, Emmett & Teller; Journal of the American Chemical Society, Vol. 60, p. 309, 1938.

The activated carbon trap is prepared for the test by attaching clamped sections of vinyl tubing to the inlet and outlet tubes of the canister. The canister is then filled with 150±10 gm. hot activated carbon which had previously been oven-dried for 3 hours at 300° F. Loss of carbon through the inlet and outlet tubes is prevented through the use of wire screens of 0.7 mm. mesh or wads of loosely packed glass wool. The canister is closed immediately after filling and the carbon is allowed to cool while the trap is vented through a drying tube via the unclamped outlet arm.

(iii) The trap is sealed and weighed after cooling and the weight, to the nearest 0.1 gram, is inscribed on the canister body. Within 12 hours of the scheduled test, the weight of the trap is checked and if it has changed by more than 0.5 gm., it is redried to constant weight. This redrying operation is performed by passing dry nitrogen, heated to 275° F., through the trap, via the inlet tube, at a rate of 1 liter per minute until checks made at 30-minute intervals do not vary by more than 0.1 percent of the gross weight. The trap and its contents are allowed to cool to room temperature, while vented through a drying tube via the outlet arm, before use.

(2) *Auxiliary collection equipment.* (i) Drying tube—transparent, tubular body $\frac{3}{4}$ inch ID, 6 inches long, with serrated tips and removable caps.

(ii) Desiccant—indicating variety, 8 mesh. The drying tube is attached to the outlet tube of the collection traps to prevent ambient moisture from entering the trap. It is prepared by filling the empty drying tube with fresh desiccant using loose wad of glass wool to hold the desiccant in place. The desiccant is renewed when three-quarters spent, as indicated by color change.

(iii) Collection tubing—stainless steel or aluminum, $\frac{5}{16}$ inch ID, for connecting the collection traps to the fuel system vents.

(iv) Polyvinyl chloride (vinyl) tubing—flexible tubing, $\frac{5}{16}$ inch ID, for sealing butt-to-butt joints.

(v) Laboratory tubing—air tight flexible tubing $\frac{5}{16}$ inch ID, attached to the outlet end of the drying tubes to equalize collection system pressure.

(vi) Clamps—hosecock, open side, for pinching off flexible tubing.

(c) *Weighing equipment.* The balance and weights used shall be capable of determining the net weight of the activated carbon trap within an accuracy of ±75 mg.

(d) *Temperature measuring equipment.* (1) Temperature recorder—multichannel, variable speed, potentiometric, or substantially equivalent, recorder with a temperature range of 50° F. to 100° F. and capable of either simultaneous or sequential recording of the ambient air and fuel temperatures within an accuracy of ±1° F.

(2) Fuel tank thermocouples—iron-constantan (type J) construction.

(e) *Assembly and use of the activated carbon vapor collection system.* (1) The prepared activated carbon trap, dried to constant weight, cooled to the ambient temperature and sealed with clamped sections of vinyl tubing is carefully weighed to the nearest 20 milligrams and the weight recorded as the "tare weight."

(2) A drying tube is attached to the outlet tube and the clamp released, but not removed. A length of flexible tubing, for pressure equalization, is connected to the other end of the drying tube.

(3) The inlet tube of the adsorption trap and external vent(s) of the fuel system will be connected by minimal lengths of stainless steel or aluminum tubing and short sections of vinyl tubing. Butt-to-butt joints shall be made wherever possible and precautions taken against sharp bends in the connection lines, including any manifold systems employed to connect multiple vents to a single trap.

(4) The clamp on the inlet tube of the trap shall be released but not removed. Care shall be exercised to prevent heating the vapor collection trap by radiant or conductive heat from the engine.

(5) Upon completion of the collection sequence, the vinyl tubing sections on each arm of the collection trap shall be clamped tight and the collection system dismantled.

(6) The sealed vapor collection trap shall be weighed carefully to the nearest 20 milligrams. This constitutes the "gross weight," which is appropriately recorded. The difference between the "gross weight" and "tare weight" represents the "net weight" for purposes of calculating the fuel vapor losses.

§ 85.83 Information to be recorded.

The following information shall be recorded with respect to each test:

(a) Test number.

(b) System or device tested (brief description).

(c) Date and time of day for each part of the test schedule.

(d) Instrument operator.
(e) Driver or operator.
(f) Vehicle: Make—Vehicle identification number—Model year—Transmission type—Odometer reading—Engine displacement—Engine family—Idle r.p.m.—Nominal fuel tank capacity and location on vehicle—Number of carburetors—Number of carburetor barrels—Inertia loading—Actual road load HP. at 50 m.p.h.
(g) Dynamometer serial number and indicated road load power absorption at 50 m.p.h.
(h) All pertinent instrument information such as tuning—gain—serial numbers—detector numbers—range.
(i) Recorder charts: Identify zero, span, exhaust gas, and dilution air sample traces.
(j) Barometric pressure, ambient temperature and humidity and the temperature of the air in front of the radiator, if any, during the test.
(k) Fuel temperatures, as prescribed.
(l) The temperature of the mixture of exhaust and dilution air entering the positive displacement pump is to be recorded continuously.
(m) The number of revolutions of the positive displacement pump accumulated while the test is in progress and exhaust flow samples are being collected.

§ 85.84 Analytical system calibration and sample handling.

(a) Calibrate HC and CO instrument assembly at least once every 30 days. Use the same flow rate as when analyzing samples.
(1) Adjust analyzers to optimize performance.
(2) Zero on prepurified air, i.e., less than 6 p.p.m. carbon equivalent of hydrocarbon and 10 p.p.m. of carbon monoxide. Check each cylinder of prepurified air for contamination with hydrocarbons and carbon monoxide.
(3) Set the CO analyzer gain to give the desired range. Select the desired attenuation scale of the HC analyzer and set the sample flow rate to give the desired range. The operating range of the analyzers shall be such that the analyzer deflection which indicates an emission level equivalent to the respective standards is in the upper half of the scale.
(4) Calibrate the HC analyzer with propane gases having nominal concentrations equivalent to 50 and 100 percent of scale. Calibrate the CO analyzer with carbon monoxide gases which are equivalent to 10, 25, 40, 50, 60, 70, 85, and 100 percent of scale. The actual concentrations should be known to within ±2 percent of the true values.
(5) Compare values obtained on the CO analyzer with previous calibration curves. Any significant change reflects some problem in the system. Locate and correct problem, and recalibrate. Use best judgment in selecting curve for data reduction.

(b) HC and CO measurements: Allow a minimum of 20 minutes warmup for the HC analyzer and 2 hours for the CO analyzer. (Power is normally left on infrared analyzers continuously; but when not in use, the chopper motor is turned off.) The following sequence of operations should be performed in conjunction with each series of measurements:
(1) Zero on prepurified air. Obtain a stable zero on the amplifier meter and recorder. Recheck after test.
(2) Introduce span gas and set the CO analyzer gain and HC analyzer sample flow rate to match calibration curves. In order to avoid correction for sample-cell pressure, span and calibrate at the same flow rates used to analyze the test samples. Span gases should have concentrations equivalent to approximately 80 percent of full scale. If gain has shifted significantly on the CO analyzer, check tuning. If necessary, check calibration. Recheck after test. Show actual concentrations on chart.
(3) Check zero, using prepurified air; repeat the procedure in subparagraphs (1) and (2) of this paragraph if required.
(4) Check flow rates and pressures.
(5) Measure HC and CO concentration of samples. Care should be exercised to prevent moisture from condensing in the sample collection bag.
(6) Check zero and span points.

§ 85.85 Dynamometer test runs.

(a) The vehicle shall be allowed to stand with engine turned off for a period of not less than 12 hours before the exhaust emission test, at an ambient temperature as specified in §§ 85.73 and 85.74. The vehicle shall be stored prior to the emission tests in such a manner that precipitation (e.g., rain or dew) does not occur on the vehicle. During the run the ambient temperature shall be between 68° F. and 86° F. For exhaust emission testing which is unrelated to fuel evaporative emission control, the ambient temperature requirement during storage shall be between 60° F. and 86° F.

(b) The following steps shall be taken for each test:
(1) Place drive wheels of vehicle on dynamometer without starting engine.
(2) Attach the flexible exhaust tube to the vehicle tailpipe(s).
(3) Start the cooling fan with the vehicle hood open (for fan specifications refer to § 85.75).
(4) Connect evacuated sample collection bags to the dilute exhaust sample and the dilution air sample line connectors.
(5) With the sample solenoid valves in the "dump" position, start the positive displacement pump, the sample pumps, and the temperature recorder. (The heat exchanger of the constant volume sampler should be preheated to its operating temperature before the test begins.)
(6) Adjust the sample flow rates to the desired flow rate (minimum of 5 c.f.h.).
(7) Simultaneously start the revolution counter for the positive displacement pump, position the sample solenoid valves to direct the sample flows into the bags, and start cranking the engine.
(8) Fifteen seconds after the engine starts, place the transmission in gear.
(9) Twenty seconds after the engine starts, begin the initial vehicle acceleration of the driving schedule.
(10) Operate the vehicle according to the dynamometer driving schedule. (§ 85.75.)
(11) Five seconds after the last deceleration, simultaneously turn off the revolution counter and position the sample solenoid valve to the "dump" position.
(12) Immediately disconnect sample bags, transfer to analytical system and process samples according to § 85.84 as soon as practicable, and in no case longer than 10 minutes after the dynamometer run.
(13) Disconnect the exhaust tube from the vehicle tailpipe(s) and remove vehicle from dynamometer.
(14) Turn off the positive displacement pump.

§ 85.86 Chart reading.

(a) Determine the HC and CO concentrations of the dilution air and dilute exhaust sample bags from the instrument deflections or recordings making use of appropriate calibration charts.

(b) Determine the average dilute exhaust mixture temperature from the temperature recorder trace.

§ 85.87 Calculations (exhaust emissions).

The final reported test results shall be computed by use of the following formulae:

(a) For light duty vehicles, excluding off-road utility vehicles:
(1) Hydrocarbon Mass:

$$HC_{mass} = V_{mix} \times Density_{HC} \times \frac{HC_{conc}}{1{,}000{,}000}$$

(2) Carbon Monoxide Mass:

$$CO_{mass} = V_{mix} \times Density_{CO} \times \frac{CO_{conc}}{100}$$

(b) For off-road utility vehicles:

(1) $$HC_{mass} = V_{mix} \times Density_{HC} \times \frac{HC_{conc} \times 0.85}{1{,}000{,}000}$$

(2) $$CO_{mass} = V_{mix} \times Density_{CO} \times \frac{CO_{conc} \times 0.85}{100}$$

(c) Meaning of symbols:

V_{mix} = Total dilute exhaust volume in cubic feet per mile, corrected to standard conditions (528° R and 760 mm. Hg).

$$V_{mix} = K_1 \times V_e \times N \times \frac{P_B}{T_P}$$

where:

$$K_1 = \frac{528° R}{760 \text{ mm. Hg} \times 7.5 \text{ miles}} = 0.00926$$

V_o=Volume of gas pumped by the positive displacement exhaust dilution pump, in cubic feet per revolution. This volume is dependent on the pressure differential across the positive displacement pump.

N=Number of revolutions of the positive displacement pump during the test while samples are being collected.

P_P=Absolute pressure of the dilute exhaust entering the positive displacement pump, i.e., barometric pressure minus the pressure depression below atmospheric of the mixture entering the positive displacement pump.

T_P=Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, in degrees Rankine.

HC_{mass}=Hydrocarbon emissions, in grams per vehicle mile.

$Density_{HC}$=Density of hydrocarbons in the exhaust gas, assuming an average carbon to hydrogen ratio of 1:1.85, in grams per cubic foot at 68° F. and 760 mm. Hg pressure (16.33 gm./cu. ft.).

HC_{conc}=Hydrocarbon concentration of the exhaust mixture sample minus hydrocarbon concentration of the dilution air sample, in p.p.m. carbon equivalent (p.p.m. C.), i.e., equivalent propane×3.

CO_{mass}=Carbon monoxide emissions, in grams per vehicle mile.

$Density_{CO}$=Density of carbon monoxide in grams per cubic foot at 68° F. and 760 mm. Hg pressure (32.97 gm./cu. ft.).

CO_{conc}=Carbon monoxide concentration of the dilute exhaust sample minus the carbon monoxide concentration of the dilution air sample, in volume percent.

(d) Example calculation of mass emission values:

Assume V_o=0.265 cu. ft. per revolution; N=20,250;
P_P=730 mm. Hg; T_P=550° R; HC_{conc}=160 p.p.m. C; and CO_{conc}=0.09%.
V_{mix}=(0.09263) (0.265) (20,250) (730/550)=659.8 cu. ft. per mile.

(1) *For a 1972 light-duty vehicle.*

$$HC_{mass}=659.8\times 16.33\times\frac{160}{1{,}000{,}000}=1.72$$

(2) *For a 1972 off-road utility vehicle.*

$$CO_{mass}=659.8\times 32.97\times\frac{0.09\times 0.85}{100}=16.6$$

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§ 85.88 Calculations (fuel evaporative emissions).

The net weights of the individual collection traps employed in § 85.74 shall be added together to determine compliance with the fuel evaporative emission standard.

§ 85.89 Test vehicles.

(a) (1) The vehicles covered by the application for certification will be divided into groupings of vehicles whose engines are expected to have similar emission characteristics. Each group of engines with similar emission characteristics shall be defined as a separate engine family.

(2) To be classed in the same engine family, engines must be identical in all the following respects:

(i) The cylinder bore center to center dimensions.

(ii) The dimension from the centerline of the crankshaft to the centerline of the camshaft.

(iii) The dimension from the centerline of the crankshaft to the top of the cylinder block head face.

(iv) The cylinder block configuration (air-cooled or water-cooled; L–6, 90° V–8, etc.).

(v) The location of intake and exhaust valves and the valve sizes (within a ⅛-inch range on the valve head diameter).

(vi) The method of air aspiration.

(vii) The combustion cycle.

(3) Engines identical in all the respects listed in subparagraph (2) of this paragraph may be further divided into different engine families if the Secretary determines that they may be expected to have different emission characteristics. This determination will be based upon a consideration of the following features of each engine:

(i) The bore and stroke.

(ii) The surface to volume ratio of the nominally dimensioned cylinder at the top dead center position.

(iii) The intake manifold induction port size and configuration.

(iv) The exhaust manifold port size and configuration.

(v) The intake and exhaust valve sizes.

(vi) The fuel system.

(vii) The camshaft timing and ignition timing characteristics.

(4) Where engines are of a type which cannot be divided into engine families based upon the criteria listed in subparagraph (2) and (3) of this paragraph, the Secretary will establish families for those engines based upon the features most related to their emission characteristics.

(b) Emission data vehicles:

(1) Vehicles will be chosen to be operated and tested for emission data based upon the engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(2) Vehicles of each engine family will be divided into engine displacement-exhaust emission control system-evaporative emission control system combinations. A projected sales volume will be established for each combination for the model year for which certification is sought. One vehicle of each combination will be selected in order of decreasing projected sales volume until 70 percent of the projected sales of a manufacturer's total production of vehicles of that engine family is represented, or until a maximum of four vehicles is selected. If any single combination represents over 70 percent, then two vehicles of that combination will be selected. The vehicle selected for each combination will be specified by the Secretary as to transmission type, fuel system and inertia weight class.

(3) The Secretary may select a maximum of four additional vehicles within each engine family based upon features indicating that they may have the highest emission levels of the vehicles in that engine family. In selecting these vehicles, the Secretary will consider such features as the emission control system combination, induction system characteristics, ignition system characteristics, fuel system, rated horsepower, rated torque, compression ratio, inertia weight class, transmission options and axle ratios.

(4) If the vehicles selected in accordance with subparagraphs (2) and (3) of this paragraph do not represent each engine-system combination, then one vehicle of each engine-system combination not represented will be selected by the Secretary. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with the control system combination in the engine family and will be designated by the Secretary as to transmission type, fuel system and inertia weight class.

(c) Durability data vehicles:

(1) A durability data vehicle will be selected by the Secretary to represent each engine-system combination. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with that control system combination in that engine family and will be designated by the Secretary as to transmission type, fuel system and inertia weight class.

(2) If an exhaust emission control system-fuel evaporative emission control system combination is used in only one engine family, an additional vehicle using that combination in that family will be selected so that the durability data fleet shall contain at least two vehicles with each combination. The additional vehicle will be selected in the same manner as vehicles selected under subparagraph (1) of this paragraph.

(3) A manufacturer may elect to operate and test additional vehicles to represent any engine-system combination. The additional vehicles must be of the same engine displacement, transmission type, fuel system and inertia weight class as the vehicle selected for that engine-system combination in accordance with the provisions of subpargraph (1) of this paragraph. Notice of an intent to operate and test additional vehicles shall be given to the Secretary not later than 30 days following notification of the test fleet selection.

(d) For purposes of testing under § 85.91(g), the Secretary may require additional emission data vehicles and durability data vehicles identical in all material respects to vehicles selected in accordance with paragraphs (b) and (c) of this section: *Provided*, That the number of vehicles selected shall not increase the size of either the emission data fleet or the durability data fleet by more than 20 percent or one vehicle, whichever is greater.

(e) Any manufacturer whose projected sales of new motor vehicles subject to this subpart for the model year for

which certification is sought is less than 2,000 vehicles may request a reduction in the number of test vehicles determined in accordance with the foregoing provisions of this section. The Secretary may agree to such lesser number as he determines would meet the objectives of this procedure.

(f) In lieu of testing an emission data or durability data vehicle selected under paragraph (b) or (c) of this section, and submitting data therefor, a manufacturer may, with the prior written approval of the Secretary, submit data on a similar vehicle for which certification has previously been obtained.

(g) (1) Where it is expected that more than 33 percent of an engine family will be equipped with an optional item, the full estimated weight of that item shall be included in the curb weight computation for the entire engine family. Where it is expected that 33 percent or less of the vehicles in an engine family will be equipped with an item of optional equipment, no weight for that item will be added in computing curb weight. Optional equipment weighing less than 3 pounds per item need not be considered.

(2) Where it is expected that more than 33 percent of an engine family will be equipped with an item of optional equipment that can reasonably be expected to influence exhaust or evaporative emissions, then such items of optional equipment shall actually be installed on all emission data and durability data vehicles for such engine family.

§ 85.90 Maintenance.

(a) (1) Maintenance on the engines and fuel systems of durability vehicles may be performed only under the following provisions:

(i) One major engine tuneup to manufacturer's specifications may be performed at 25,000 miles (±250 miles) of scheduled driving with the following exception: On a vehicle with an engine displacement of 150 cubic inches or less (or a rating of at least 1.20 S.A.E. horsepower per cubic inch of displacement) major engine tuneups may be performed at 12,000, 24,000, and 36,000 miles (±250 miles) of scheduled driving. A major engine tuneup shall be restricted to the following:

(*a*) Replace spark plugs.

(*b*) Inspect ignition wiring and replace as required.

(*c*) Replace distributor breaker points and condensor as required.

(*d*) Lubricate distributor cam.

(*e*) Check distributor advance and breaker point dwell angle and adjust as required.

(*f*) Check automatic choke for free operation and correct as required.

(*g*) Adjust carburetor idle speed and mixture.

(*h*) Adjust drive belt tension on engine accessories.

(*i*) Adjust valve lash if required.

(*j*) Check exhaust heat control valve for free operation.

(*k*) Check engine bolt torque and tighten as required.

(ii) Spark plugs may be changed if a persistent misfire is detected.

(iii) Normal vehicle lubrication services (engine and transmission oil change and oil filter, fuel filter, and air filter servicing) will be allowed at manufacturer's recommended intervals.

(iv) The crankcase emission control system may be serviced at 12,000-mile intervals (±250 miles) of scheduled driving.

(v) The fuel evaporative emission control system may be serviced at 12,000-mile intervals (±250 miles) of schedule driving.

(vi) Readjustment of the engine choke mechanism or idle settings may be performed only if there is a problem of stalling at stops.

(vii) Leaks in the fuel system, engine lubrication system and cooling system may be repaired.

(viii) Any other engine or fuel system maintenance or repairs will be allowed only with the advance approval of the Secretary.

(2) Repairs to vehicle components of the durability data vehicle, other than the engine or fuel system, shall be performed only as a result of part failure or vehicle system malfunction.

(3) Allowable maintenance on emission data vehicles shall be limited to the adjustment of engine idle speed at the 4,000-mile test point.

(4) Where the Secretary agrees under § 85.91 to a mileage accumulation of less than 50,000 miles for durability testing, he may modify the requirements of this paragraph.

(b) Complete emission tests (see §§ 85.71–85.88) shall be run before and after any vehicle maintenance which may reasonably be expected to affect emissions. These test data shall be supplied to the Secretary immediately after the tests, along with a complete record of all pertinent maintenance, including an engineering report of any malfunction diagnosis and the corrective action taken. In addition, all test data and maintenance reports shall be compiled and provided to the Secretary in accordance with § 85.53.

(c) If the Secretary determines that maintenance or repairs performed have resulted in a substantial change to the engine-system combination, the vehicle shall not be used as a durability data vehicle.

§ 85.91 Mileage accumulation and emission measurements.

The procedure for mileage accumulation will be the Durability Driving Schedule as specified in appendix C to this part. A modified procedure may also be used if approved in advance by the Secretary.

(a) Emission data vehicles: Each emission data vehicle shall be driven 4,000 miles with all emission control systems installed and operating. Emission tests shall be conducted at zero miles and 4,000 miles.

(b) Durability data vehicles: Each durability data vehicle shall be driven, with all emission control systems installed and operating, for 50,000 miles or such lesser distance as the Secretary may agree to as meeting the objectives of this procedure. Emission measurements from a cold start shall be made at zero miles and at each 4,000-mile interval.

(c) All tests required by this subpart to be conducted after 4,000 miles of driving or at any multiple of 4,000 miles may be conducted at any accumulated mileage within 250 miles of 4,000 miles or the appropriate multiple of 4,000 miles, respectively.

(d) The results of each emission test shall be supplied to the Secretary immediately after the test. In addition, all test data shall be compiled and provided to the Secretary in accordance with § 85.53.

(e) Whenever the manufacturer proposes to operate and test a vehicle which may be used for emission or durability data, he shall provide the zero mile test data to the Secretary and make the vehicle available for such testing under § 85.54 as the Secretary may require before beginning to accumulate mileage on the vehicle. Failure to comply with this requirement will invalidate all test data submitted for this vehicle.

(f) Once a manufacturer begins to operate an emission data or durability data vehicle, as indicated by compliance with paragraph (e) of this section, he shall continue to run the vehicle to 4,000 miles or 50,000 miles, respectively, and the data from the vehicle will be used in the calculations under § 85.92. Discontinuation of a vehicle shall be allowed only with the written consent of the Secretary.

(g) (1) The Secretary may elect to operate and test any test vehicle during all or any part of the mileage accumulation and testing procedure. In such cases, the manufacturer shall provide the vehicle(s) to the Secretary with all information necessary to conduct this testing.

(2) The test procedures (§§ 85.71–85.88) will be followed by the Secretary. The Secretary will test the vehicles at each test point. Maintenance may be performed by the manufacturer under such conditions as the Secretary may prescribe.

(3) The data developed by the Secretary for the engine-system combination shall be combined with any applicable data supplied by the manufacturer on other vehicles of that combination to determine the applicable deterioration factors for the combination. In the case of a significant discrepancy between data developed by the Secretary and that submitted by the manufacturer, the Secretary's data shall be used in the determination of deterioration factors.

§ 85.92 Compliance with emission standards.

(a) The exhaust and fuel evaporative emission standards in the regulations in this part apply to the average lifetime emissions of vehicles in public use. Prior to certification, lifetime emissions can be obtained by projection of test data to lifetime normal service. Normal service in an urban area or its equivalent for 100,000 miles is taken as the basis for "lifetime emissions."

(b) It is expected that emission control efficiency will change with mileage accumulation on the vehicle. It is assumed that the emission level of a vehicle which has accumulated 50,000 miles in normal service is the average emission level of that vehicle over its lifetime.

(c) The procedure for determining compliance of a new light-duty motor vehicle with exhaust and fuel evaporative emission standards is as follows:

(1) Separate emission deterioration factors shall be determined from the emission results of the durability data vehicles for each engine-system combination. A separate factor shall be established for the combination for exhaust HC, exhaust CO, and fuel evaporative HC.

(i) The applicable results to be used in determining the deterioration factors for each combination shall be:

(*a*) All emission data from the tests required under § 85.91(b), except the zero mile tests. This shall include the official test results, as determined in § 85.54, for all tests conducted on all durability vehicles of the combination selected under § 85.89(c) (including all vehicles elected to be operated by the manufacturer under § 85.89(c)(3)).

(*b*) All emission data from the tests conducted before and after the maintenance provided in § 85.90(a)(1)(i).

(ii) All applicable results shall be plotted as a function of the mileage on the system, rounded to the nearest mile, and the best fit straight lines, fitted by the method of least squares, shall be drawn through these data points. The interpolated 4,000- and 50,000-mile points on this line must be within the standards provided in §§ 85.21 and 85.22 or the data will not be acceptable for use in calculation of a deterioration factor.

(iii) An exhaust emission deterioration factor shall be calculated for each combination as follows:

$$\text{factor} = \frac{\text{exhaust emissions interpolated to 50,000 miles}}{\text{exhaust emissions interpolated to 4,000 miles}}$$

(iv) An evaporative emission deterioration factor shall be calculated for each combination by substracting the evaporative emissions interpolated to 4,000 miles from the evaporative emissions interpolated to 50,000 miles.

(2) (i) The exhaust emission test results for each emission data vehicle shall be multiplied by the appropriate deterioration factor: *Provided,* That if a deterioration factor as computed in subparagraph (1)(iii) of this paragraph is less than one, that deterioration factor shall be one for the purposes of this subparagraph.

(ii) The evaporative emission test results for each combination shall be adjusted by addition of the appropriate deterioration factor: *Provided,* That if a deterioration factor as computed in subparagraph (1)(iv) of this paragraph is less than zero, that deterioration factor shall be zero for the purposes of this subparagraph.

(3) The emissions to compare with the standard shall be the adjusted emissions of subparagraph (2) (i) and (ii) of this paragraph for each emission data vehicle.

(4) Every test vehicle of an engine family must comply with all applicable standards, as determined in subparagraph (3) of this paragraph, before any vehicle in that family may be certified.

Subpart I—Test Procedures for Engine Exhaust Emissions (Gasoline Fueled Heavy Duty Engines)

§ 85.100 Introduction.

The procedures described in this subpart will be the test program to determine the conformity of new gasoline fueled heavy duty engines with the applicable standards set forth in this part.

(a) The test consists of prescribed sequences of engine operating conditions to be conducted on an engine dynamometer. The exhaust gases generated during engine operation are sampled continuously for specific component analysis through the analytical train. The tests are applicable to engines equipped with catalytic or direct-flame afterburners, induction system modifications, or other systems, or to uncontrolled engines.

(b) The exhaust emission test is designed to determine hydrocarbon and carbon monoxide concentrations during a truck driving pattern in a metropolitan area as simulated on an engine dynamometer. The test consists of two warmup cycles and two hot cycles. The average concentrations for the warmup cycles and the hot cycles are combined to yield the reported values.

(c) When an engine is tested for exhaust emissions or is operated for durability testing on an engine dynamometer the complete engine shall be used with all accessories which might reasonably be expected to influence emissions to the atmosphere installed and functioning.

§ 85.101 Gasoline fuel specifications.

(a) For exhaust emission testing, fuel having specifications as shown in the table in § 85.71(a), or substantially equivalent specifications approved by the Secretary, shall be used.

(b) For durability testing, fuel having specifications as shown in the table in § 85.71(b), or substantially equivalent specifications approved by the Secretary, shall be used. The octane rating of the fuel used shall be in the range recommended by the engine manufacturer. The specifications of the fuel to be used shall be reported in accordance with § 85.51(b)(3).

§ 85.102 Dynamometer operation cycle and equipment.

(a) (1) The following nine-mode cycle shall be followed in dynamometer operation tests of gasoline fueled heavy duty engines.

Sequence No.	Mode	Manifold vacuum	Time in Mode-Secs.	Cumulative Time-Secs.	Weighting factors
1	Idle		70	70	0.036
2	Cruise	16" Hg	23	93	.089
3	PTA	10" Hg	44	137	.257
4	Cruise	16" Hg	23	160	.089
5	PTD	19"Hg	17	177	.047
6	Cruise	16" Hg	23	200	.089
7	FL	3" Hg	34	234	.283
8	Cruise	16" Hg	23	257	.089
9	CT		43	300	.021

(2) The engine dynamometer shall be operated at a constant speed of 2,000 r.p.m.±100 r.p.m. (exception: representative engine speed for a given displacement engine as determined by its application, but not less than 1,800 r.p.m. nor greater than 2,500 r.p.m.).

(3) The idle operating mode shall be carried out at the manufacturer's recommended engine speed. The CT operating mode shall be carried out at the same engine speed as in subparagraph (2) of this paragraph.

(b) The following equipment shall be used for dynamometer tests.

(1) An engine dynamometer capable of maintaining constant speed±100 r.p.m. from full throttle to closed throttle motoring.

(2) A chassis-type exhaust system or substantially equivalent exhaust system, shall be used.

(3) A radiator typical of that used with the engine in a vehicle, or other means of engine cooling which will maintain the engine operating temperatures at approximately the same temperature as would the radiator, shall be used. An auxiliary fixed speed fan may be used to maintain engine cooling during sustained operation on the dynamometer.

§ 85.103 Dynamometer procedures.

An initial 5-minute idle, two warmup cycles, and two hot cycles constitute a a complete dynamometer run. Idle modes may be run at the beginning and end of each test, thus eliminating the need to change speed between cycles. One idle mode preceding the first cycle and one following the fourth cycle is sufficient. The results of the first idle shall be used for calculation of the second cycle emissions and the fourth idle results shall be used for calculation of the third cycle emissions.

§ 85.104 Sampling and analytical system for measuring exhaust emissions.

(a) *Schematic drawing.* The following (fig. 6) is a schematic drawing of the exhaust gas sampling and analytical system which shall be used for testing under the regulations in this subpart.

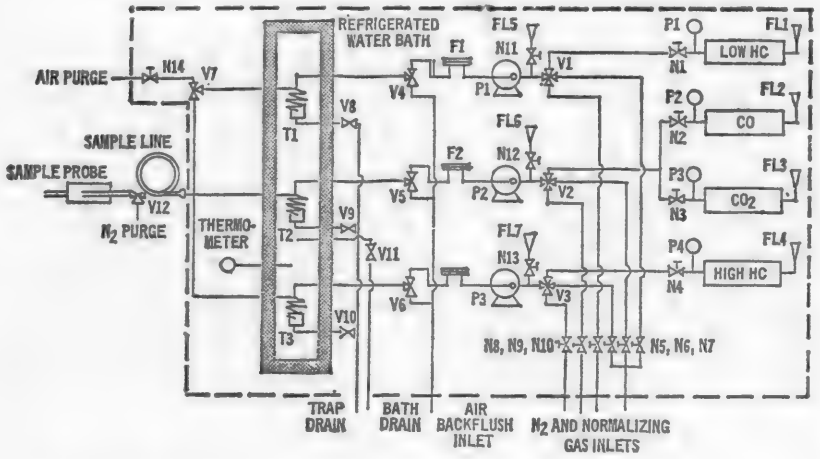


Figure 8. Flow schematic of exhaust gas analysis system employed in Federal facilities.

(b) *Component description.* The following components shall be used in sampling and analytical systems for testing under the regulations in this part.

(1) Flowmeters FL1, FL2, FL3, and FL4 indicate the sample flow rate through the analyzers.

(2) Low range hydrocarbon analyzer.

(3) Carbon monoxide analyzer.

(4) Carbon dioxide analyzer.

(5) High range hydrocarbon analyzer.

(6) Pressure gauges P1, P2, and P3 indicate the analyzer sample pressure.

(7) Needle valves N1, N2, N3, and N4 regulate sample flow rate to the analyzers.

(8) Needle valves N5, N6, N7, N8, N9, and N10 regulate the flow rates of N_2 and normalizing gases to the analyzers.

(9) Ball valves V1, V2, and V3 for directing either sample or calibration gases to the analyzers.

(10) Needle valves N11, N12, and N13 regulate the sample flow rate through the bypass network.

(11) Flowmeters FL5, FL6, and FL7 indicate the flow rate through the bypass system.

(12) Pumps P1, P2, and P3 for pulling sample from source.

(13) Filters F1, F2, and F3 remove contaminants from sample prior to analysis.

(14) Ball valves V4, V5, and V6 for directing sample to the analyzer or directing air in the reverse direction as a backflush.

(15) Toggle valves V8, V9, V10, and V11 for draining condensate traps and refrigerated bath.

(16) Traps T1, T2, and T3 for condensing water vapor and cooling exhaust sample.

(17) Ball valve V7 for diverting air to low HC analyzer during periods of high hydrocarbon response.

(18) Needle valve N14 for regulating air flow to low hydrocarbon analyzer during purge conditions.

(19) Thermometer for indicating bath temperature.

(20) Refrigerated water bath for condensing water vapor and cooling exhaust sample.

(21) Sample line from vehicle to analysis system.

(22) Sample probe to extract exhaust gas sample from terminus of vehicle exhaust system.

(23) Ball valve V12 for directing N_2 to hydrocarbon analyzers.

(c) *Hang up reduction.* Stringent methods to reduce hang up may be employed. All methods must be approved in advance by the Secretary.

§ 85.105 Information to be recorder on charts.

The following informatioin shall be recorded with respect to each test:

(a) Test number.

(b) System tested (brief description).

(c) Date and time of day for each part of the test schedule.

(d) Instrument Operator.

(e) Driver or Operator.

(f) Engine Make—identification number—date of manufacture—number of hours — engine displacement — engine family—idle r.p.m.—number carburetors—number of carburetor venturis.

(g) All pertinent instrument information such as tuning—gain—serial numbers—detector numbers—range.

(h) Recorder Charts: Identify zero, span, exhaust gas sample traces.

(i) Barometric pressure, intake air temperature and humidity and, as applicable, the temperature of the air in front of the radiator during the test.

(j) A continuous trace of intake manifold vacuum and engine r.p.m., recorded on the same chart with an automatic marker indicating one second intervals.

§ 85.106 Calibration and instrument checks.

(a) The instrument assembly shall be calibrated at least once every 30 days, using the same flow rate as when sampling exhaust and proceeding as follows:

(1) Tune analyzers.

(2) Zero on nitrogen: Check each cylinder of N_2 for contamination with hydrocarbons. Set the instrument gain to give the desired range. Normal operating ranges are as follows:

Low-Range Hydrocarbon Analyzer.	0–1,000 p.p.m. hexane equivalent.
High-Range Hydrocarbon Analyzer.	0–10,000 p.p.m. hexane equivalent.
CO Analyzer	0–10% CO.
CO_2 Analyzer	0–16% CO_2.

(3) Calibrate with the following normalizing gases. Flow rates should be set at 10 c.f.h. on the hydrocarbon analyzers and 5 c.f.h. on the carbon monoxide and carbon dioxide analyzers. The concentrations given indicate nominal concentrations, and actual concentrations should be known to within ±2 percent of true value. Prepurified N_2 is used as the diluent.

Low range HC analyzer	High range HC analyzer	CO and CO_2 analyzers		
		Blend of CO and CO_2 containing:		
Hexane equivalent [1]	*Hexane equivalent*	*Mole percent CO*	Plus	*Mole percent* CO_2
100 p.p.m.	600 p.p.m.	0.5		16.0
200 p.p.m.	1,000 p.p.m.	1.0		15.0
300 p.p.m.	1,500 p.p.m.	2.0		14.0
400 p.p.m.	2,500 p.p.m.	3.0		13.0
600 p.p.m.	4,000 p.p.m.	4.0		12.0
800 p.p.m.	6,000 p.p.m.	6.0		10.0
1,000 p.p.m.	8,000 p.p.m.	8.0		8.0
	10,000 p.p.m.	10.0		6.0

[1] The hexane equivalent of propane, when used as the normalizing gas for calibrating nondispersive infrared analyzers, is prescribed to be 0.52 (Propane Concentration×0.52=Hexane Equivalent Concentration).

Minimum storage temperature of the cylinders shall be 60° F.; minimum use temperature shall be 68° F.

(4) Compare values with previous curves. Any significant change reflects some problem in the system. Locate and correct problem, and recalibrate. Use best judgment in selecting curve for data reduction.

(5) Check response of hydrocarbon analyzer to 100 percent CO_2. If response is greater than 0.5 percent full scale, refill filter cells with 100 percent CO_2 and recheck. Note any remaining response on chart. If response still exceeds 0.5 percent, replace detector.

(6) Check response of hydrocarbon analyzers to nitrogen saturated with water at ambient temperature. Record ambient temperature. If the low-range instrument response exceeds 5 percent of full scale with saturated nitrogen at 75° F., replace the detector. If the high-range response exceeds 0.5 percent of full scale, check detector on low-range instrument, then reject if response exceeds 5 percent of full scale at 75° F.

(b) The following daily instrument check shall be performed, allowing a minimum of 2 hours warmup for infrared analyzers. (Power is normally left on continuously; but, when instruments are not in use, chopper motor is turned off.):

(1) Zero on clean nitrogen introduced at analyzer inlet. Obtain a stable zero on the amplifier meter and recorder. Recheck after test.

(2) Introduce normalizing gas and set gain to match calibration curve. In order to avoid a correction for sample cell pressure, normalize and calibrate at the same flow rates used for exhaust sampling. Normalizing or span gases: (See paragraph (a)(3) of this section for allowable variation.)

Low-Range Hydrocarbon Analyzer.	1,000 p.p.m. hexane equivalent in prepurified N_2.
High-Range Hydrocarbon Analyzer.	10,000 p.p.m. hexane equivalent in prepurified N_2.
CO Analyzer	10% CO in prepurified N_2.
CO_2 Analyzer	12 to 16% CO_2 in prepurified N_2.

If gain has shifted significantly, check tuning. If necessary, check calibration. Recheck after test. Record actual concentrations on chart.

(3) Check nitrogen zero, repeat the procedure in subparagraphs (1) and (2) of this paragraph if required.

(4) Check flow rates and pressures.

§ 85.107 Dynamometer test run.

(a) The engine shall be allowed to stand with engine turned off for at least 1 hour before the exhaust emission test at an ambient temperature of 60° F. to 86° F. The engine shall be stored prior to the emission tests in such a manner that it is not exposed to precipitation or condensation. During the dynamometer run, the ambient temperature shall be between 68° F. and 86° F.

(b) The following steps shall be taken for each test:

(1) Mount test engine on the engine dynamometer.

(2) Calibrate exhaust emission analyzer assembly.

(3) Start cooling system, if it is to be used.

(4) Start engine and idle at 1,000–1,200 r.p.m. for 5 minutes.

(5) Obtain normal idle speed, record it, and start exhaust sampling.

(6) Run four 9-mode cycles.

(c) Upon completion of the test, purge the sample line with nitrogen to establish a constant hydrocarbon "hangup" level. The hydrocarbon concentration shall drop to 5 percent of scale in 10 seconds, and 3 percent of scale in 3 minutes, or the test is invalid. Check calibration of exhaust emission instruments. A drift in excess of ±2 percent of scale in the calibration of any one of the exhaust emission analyzers will invalidate the test results.

§ 85.108 Chart reading.

The recorder response for measuring exhaust gas concentrations always lags the engine's operation because of a variable exhaust system delay and a fixed sample system delay. Therefore, the concentrations for each mode will not be located on the charts at a point corresponding to the exact time of the mode. For each warmup or hot cycle to be evaluated, proceed as follows:

(a) Determine whether the cycle was run in accordance with the specified cycle timing by observing either chart pips, speed trace, manifold vacuum trace, or concentration traces. Deviation by more than 2 seconds from the specified time for the closed throttle mode (sequence 9) or deviation of more than ±0.2" Hg from the specified mode vacuums during the last 10 seconds of a mode will invalidate the data.

(b) Time correlate the hydrocarbon, carbon monoxide, and carbon dioxide charts. Determine the location on the chart of concentrations corresponding to each mode. Determine and compensate for trace abnormalities.

(c) For all open throttle (3", 10", 16", and 19" Hg) and idle modes, integrate the last 3 seconds of the HC, CO and CO_2 traces.

(d) The values recorded for the initial idle mode are used for both warmup cycles 1 and 2. The final idle mode values are applied to hot cycles 3 and 4.

(e) Intergrate the complete HC, CO, and CO_2 traces during this 43-second closed throttle mode of each cycle.

(f) Direct computer analysis of analyzer output may be utilized provided that the analysis is sufficiently similar to the above procedures to result in comparable data results.

§ 85.109 Calculations.

The final reported test results shall be derived through the following steps:

(a) Determine composite hydrocarbon and carbon monoxide concentrations for the first and second cycles. Average the results of these two cycles.

(b) Determine composite hydrocarbon and carbon monoxide concentrations for the third and fourth cycles. Average the results of these two cycles.

(c) Combine the results of paragraphs (a) and (b) of this section according to the formula: 0.35(a) plus 0.65(b). Since hydrocarbon, carbon monoxide, and carbon dioxide are all measured with essentially the same moisture content, no moisture correction is required to convert the results to a dry basis. The correction factor:

$$\frac{14.5}{\%\,CO_2 + (0.5)\,\%\,CO + (1.8\times 6)\,\%\,HC}$$

shall be applied to the measured concentrations of hydrocarbon and carbon monoxide to correct these observed values for dilution of the exhaust.

§ 85.110 Test engines.

(a) The engines covered by the application for certification will be divided into engine families based upon the criteria outlined in § 85.89(a).

(b) Emission data engines:

(1) Engines will be chosen to be run for emission data based upon the engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(2) Engines of each engine family will be divided into engine displacement-exhaust emission control system combinations. A projected sales volume will be established for each combination for the model year for which certification is sought. One engine of each combination will be selected in order of decreasing projected sales volume until 70 percent of the projected sales of a manufacturer's total production of engines of that family is represented, or until a maximum of four engines is selected. The engines selected for each combination will be specified by the Secretary as to fuel system.

(3) The Secretary may select a maximum of two additional engines within each engine family based upon features indicating that they may have the highest emission levels of the engines in that engine family. In selecting these engines, the Secretary will consider such features as the exhaust emission control system, induction system characteristics, ignition system characteristics, fuel system, rated horsepower, rated torque, and compression ratio.

(4) If the engines selected in accordance with subparagraphs (2) and (3) of this paragraph do not represent each engine-system combination, then one engine of each engine-system combination not represented shall be selected by the Secretary. The engine selected shall be of the displacement with the largest projected sales volume of engines with the exhaust emission control system in the family and will be designated by the Secretary as to fuel system.

(c) Durability data engines:

(1) A durability data engine will be selected by the Secretary to represent each engine-system combination. The engine selected shall be of the displacement with the largest projected sales volume of engines with that exhaust emission control system in that engine family and will be designated by the Secretary as to fuel system.

(2) If an exhaust emission control system is used in only one engine family, an additional engine using that control system in that family will be selected so that the durability data fleet shall contain at least two engines with each control system. The additional engine will be selected in the same manner as engines selected under subparagraph (1) of this paragraph.

(3) A manufacturer may elect to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same engine displacement and fuel system as the engine selected for that combination in accordance with the provisions of subparagraph (1) of this paragraph. Notice of an intent to run additional engines shall be given to the Secretary not later than 30 days following notification of the test fleet selection.

(d) Any manufacturer whose projected sales of new motor vehicle engines subject to this subpart for the model year for which certification is sought is less than 700 engines may request a reduction in the number of test engines determined

in accordance with the foregoing provisions of this section. The Secretary may agree to such lesser number as he determines will meet the objectives of this procedure.

(e) In lieu of testing an emission data or durability data vehicle selected under paragraph (b) or (c) of this section and submitting data therefor, a manufacturer may, with the prior written approval of the Secretary, submit data on a similar vehicle for which certification has previously been obtained.

§ 85.111 Maintenance.

(a) (1) Maintenance on the engines and fuel systems of durability engines may be performed only under the following provisions:

(i) Two major engine tuneups to manufacturer's specifications may be performed at 500 and 1,000 hours (±8 hours) of scheduled dynamometer operation with the following exception: On engines with a displacement of 200 cubic inches or less, a major engine tuneup may be performed at 375, 750, and 1,125 hours (±8 hours) of scheduled dynamometer operation. A major engine tuneup shall be restricted to the following:

(*a*) Replace spark plugs.

(*b*) Inspect ignition wiring and replace as required.

(*c*) Replace distributor breaker points and condensor as required.

(*d*) Lubricate distributor cam.

(*e*) Check distributor advance and breaker point dwell angle and adjust as required.

(*f*) Check automatic choke for free operation and correct as required.

(*g*) Adjust carburetor idle speed and mixture.

(*h*) Adjust drive belt tension on engine accessories.

(*i*) Adjust valve lash if required.

(*j*) Check exhaust heat control valve for free operation.

(*k*) Check engine bolt torque and tighten as required.

(ii) Spark plugs may be changed if a persistent misfire is detected.

(iii) Normal services (engine oil change, and oil filter, fuel filter and air filter servicing) will be allowed at manufacturer's recommended intervals.

(iv) The crankcase emission control system may be serviced at 375-hour intervals (±8 hours) of dynamometer operation.

(v) Readjustment of the engine choke mechanism or idle settings may be performed only if there is a problem of stalling at idle.

(vi) Leaks in the fuel system, engine lubrication system and cooling system may be repaired.

(vii) Any other engine or fuel system maintenance or repairs will be allowed only with the advance approval of the Secretary.

(2) Allowable maintenance on emission data engines shall be limited to the adjustment of engine idle speed at the 125-hour test point.

(b) Complete emission tests (see §§ 85.101–85.109) shall be run before and after any engine maintenance which may reasonably be expected to affect emissions. These test data shall be supplied to the Secretary immediately after the tests, along with a complete record of all pertinent maintenance, including an engineering report of any malfunction diagnosis and the corrective action taken. In addition, all test data and maintenance reports shall be compiled and provided to the Secretary in accordance with §85.53.

(c) If the Secretary determines that maintenance or repairs have resulted in a substantial change to the engine-system combination, the engine shall not be used as a durability data engine.

§ 85.112 Service accumulation and emission measurements.

The engine dynamometer service accumulation schedule will consist of several operating conditions which give the same percentage of time at various manifold vacuums and the modes as specified in the emission test cycle. The average speed shall be between 1,650 and 1,700 r.p.m. with some operation at 3,200 r.p.m. or governed speed, whichever is lower. Maximum cycle time shall be 15 minutes. A cycle approved in advance by the Secretary shall be used.

(a) Emission data engines: Each emission data engine shall be operated for 125 hours with all emission contol systems installed and operating. Emission tests shall be conducted at zero and 125 hours.

(b) Durability data engines: Each durability data engine shall be operated, with all emission control systems installed and operating, for 1,500 hours. Emission measurements, as prescribed, shall be made at zero hours and at each 125-hour interval.

(c) All tests required by this subpart to be conducted after 125 hours of operation or at any multiple of 125 hours may be conducted at any accumulated number of hours within 8 hours of 125 hours or the appropriate multiple of 125 hours, respectively.

(d) The results of each emission test shall be supplied to the Secretary immediately after the test. In addition, all test data shall be compiled and provided to the Secretary in accordance with § 85.53.

(e) Whenever the manufacturer proposes to operate and test an engine which may be used for emission or durability data, he shall provide the zero-hour test data to the Secretary and make the engine available for such testing under § 85.54 as the Secretary may require, before beginning to accumulate hours on the engine. Failure to comply with this requirement will invalidate all test data later submitted for this engine.

(f) Once a manufacturer begins to operate an emission data or durability data engine, as indicated by compliance with paragraph (e) of this section, he shall continue to run the engine to 125 hours or 1,500 hours, respectively, and the data from the engine will be used in the calculations under § 85.113. Discontinuation of an engine shall be allowed only with the prior written consent of the Secretary.

§ 85.113 Compliance with emission standards.

(a) The exhaust emission standards in the regulations in this part apply to the average lifetime emissions of engines in public use. Prior to certification, lifetime emissions can be obtained by projection of test data to lifetime normal service. Normal service in an urban area or its equivalent for 100,000 miles is taken as the basis for "lifetime emissions." Operation on an engine dynamometer in the prescribed manner for 3,000 hours is taken to be equivalent to such service.

(b) It is expected that emission control efficiency will change with the accumulation of hours on the engine. It is assumed that the emission level of an engine which has accumlated 1,500 hours of dynamometer operation is the average emission level of that engine over its lifetime.

(c) The procedure for determining compliance of a new engine with exhaust emission standards is as follows:

(1) Separate emission deterioration factors shall be determined from the emission results of the durability data engines for each engine-system combination. Separate factors shall be established for HC and CO for each combination.

(i) The applicable results to be used in determining the deterioration factors for each combination shall be:

(*a*) All emission data from the tests required under § 85.112(b), except the zero-hour tests. This shall include the official test results, as determined in § 85.54, for all tests conducted on all durability engines of the combination selected under § 85.110(c) (including all engines elected to be operated by the manufacturer under § 85.110(c)(4)).

(*b*) All emission data from the tests conducted before and after the maintenance provided in § 85.111(a)(1)(i).

(ii) All applicable results shall be plotted as a function of the hours on the system, rounded to the nearest hour, and the best fit straight lines, fitted by the method of least squares, shall be drawn through these data points. The interpolated 125- and 1,500-hour points on this line must be within the standard provided in § 85.31 or the data shall not be used in calculation of a deterioration factor.

(iii) An exhaust emission deterioration factor shall be calculated for each combination as follows:

$$\text{factor} = \frac{\text{exhaust emissions interpolated to 1,500 hours}}{\text{exhaust emissions interpolated to 125 hours}}$$

(2) The exhaust emission test results for each emission data engine shall be multiplied by the appropriate deterioration factor: *Provided*, That if a deterioration factor as computed in subparagraph (1) of this paragraph is less than one, that deterioration factor shall be one for the purposes of this subparagraph.

(3) The emissions to compare with the standard shall be the adjusted emissions of subparagraph (2) of this paragraph for each emission data engine.

(4) Every test engine of an engine family must comply with all applicable standards, as determined in subparagraph (3) of this paragraph, before any engine in that family will be certified.

Subpart J—Test Procedures for Engine Exhaust Emissions (Heavy Duty Diesel Engines)

§ 85.120 Introduction.

(a) The procedures described in this subpart will be the test program to determine the conformity of heavy duty diesel engines with the applicable standards set forth in this part:

(b) The test consists of a prescribed sequence of engine operating conditions on an engine dynamometer with continuous examination of the exhaust gases. The test is applicable equally to controlled engines equipped with means for preventing, controlling, or eliminating smoke emissions and to uncontrolled engines.

(c) The test is designed to determine the opacity of smoke in exhaust emissions during those engine operating conditions which tend to promote smoke from diesel-powered vehicles.

(d) The test procedure begins with a warm engine which is then run through preloading and preconditioning operations. After an idling period, the engine is operated through acceleration and lugging modes during which smoke emission measurements are made to compare with the standards. The engine is then returned to the idle condition and the acceleration and lugging modes are repeated. Three sequences of acceleration and lugging constitute the full set of operating conditions for smoke emission measurement.

§ 85.121 Diesel fuel specifications.

(a) The diesel fuels employed shall be clean and bright, with pour and cloud points adequate for operability. The fuels may contain nonmetallic additives as follows: cetane improver, metal deactivator, antioxidant, dehazer, antirust, pour depressant, dye, and dispersant.

(b) Fuel meeting the following specifications, or substantially equivalent specifications approved by the Secretary, shall be used in exhaust emission testing. The grade of fuel recommended by the engine manufacturer, commercially designated as "Type 1–D" or "Type 2–D", shall be used.

Item	ASTM test method No.	Type 1–D	Type 2–D
Cetane	D 613	45–54	42–50
Distillation range	D 86		
IBP, °F		330–390	340–400
10 percent point, °F		370–430	400–460
50 percent point, °F		410–480	470–540
90 percent point, °F		460–520	550–610
EP, °F		500–560	580–660
Gravity, ° API	D 287	40–44	33–37
Total sulfur, percent	D 129 or D 2622	0.05–0.20	0.2–0.5
Hydrocarbon composition	D 1319		
Aromatics, percent		8–15	27 (Min.)
Paraffins, Naphthenes, Olefins		Remainder	Remainder
Flash point, °F (Min.)	D 93	120	130
Viscosity, centistokes	D 445	1.6–2.0	2.0–3.2

(c) Fuel meeting the following specifications, or substantially equivalent specifications approved by the Secretary, shall be used in service accumulation. The grade of fuel recommended by the engine manufacturer, commercially designated as "Type 1–D" or "Type 2–D", shall be used.

Item	ASTM test method No.	Type 1–D	Type 2–D
Cetane	D 613	48–54	42–55
Distillation range	D 86		
IBP, °F		303–390	340–410
10 percent point, °F		370–430	400–470
50 percent point, °F		410–480	470–540
90 percent point, °F		460–520	550–610
EP, °F		500–560	580–660
Gravity, °API	D 287	40–44	33–40
Total sulfur, percent	D 129 or D 2622	0.05–0.20	0.2–0.5
Flash point, °F (Min.)	D 93	120	130
Viscosity, centistokes	D 445	1.6–2.0	2.0–3.2

(d) The type fuel, including additive and other specifications, used under paragraphs (b) and (c) of this section shall be reported in accordance with § 85.51(b)(3).

§ 85.122 Dynamometer operation cycle for smoke emission tests.

(a) The following sequence of operations shall be performed during engine dynamometer testing of smoke emissions, starting with the dynamometer preloading determined and the engine preconditioned (§ 85.127(c)).

(1) *Idle mode.* The engine is caused to idle for 5 minutes at the manufacturer's recommended low idle speed. The dynamometer controls shall be set to provide minimum load by turning the load switch to the "off" position or by adjusting the controls to the minimum load position.

(2) *Acceleration mode.* (i) The engine speed shall be increased to 200±50 r.p.m. above the manufacturer's recommended low idle speed.

(ii) The engine shall be accelerated at full-throttle against the inertia of the engine and dynamometer or alternately against a preselected dynamometer load such that the engine speed reaches 85 to 90 percent of rated speed in 5±1.5 seconds.

(iii) When the engine reaches the speed required in subdivision (ii) of this subparagraph, the throttle shall be moved rapidly to the closed position and the dynamometer load, if any, shall be removed. The engine speed shall be reduced to the speed of maximum rated torque or 60 percent of rated speed (whichever is higher), within ±50 r.p.m. Smoke emissions during this transitional mode are not used in determining smoke emissions to compare with the standard.

(iv) The throttle shall be moved rapidly to the full-throttle position while simultaneously applying a preselected dynamometer load such that the engine speed reaches 95 to 100 percent of rated speed in 10±2 seconds.

(3) *Lugging mode.* (i) Proceeding from the acceleration mode, the dynamometer controls shall be adjusted to permit the engine to develop maximum horsepower at rated speed. Smoke emissions during this transitional mode are not used in determining smoke emissions to compare with the standard.

(ii) Without changing the throttle position, the dynamometer controls shall be adjusted gradually to slow the engine to the speed of maximum torque or to 60 percent of rated speed, whichever is higher. This engine lugging operation shall be performed smoothly over a period of 35±5 seconds. The rate of slowing of the engine shall be linear, within ±100 r.p.m.

(4) *Engine unloading.* After completion of the lugging mode in subparagraph (3)(ii) of this paragraph, the dynamometer and engine shall be returned to the idle condition described in subparagraph (1) of this paragraph.

(b) The procedures described in paragraph (a) (1) through (4) of this section shall be repeated until the entire cycle has been run three times.

§ 85.123 Dynamometer and engine equipment.

The following equipment shall be used for smoke emission testing of engines on engine dynamometers.

(a) An engine dynamometer with adequate characteristics to perform the test cycle described in § 85.122.

(b) An engine cooling system having sufficient capacity to maintain the engine at normal operating temperatures during conduct of the prescribed engine tests.

(c) A noninsulated exhaust system extending 12±2 feet from the exhaust manifold of the engine and presenting an exhaust back pressure within ±0.2 inches Hg of the upper limit at maximum rated horsepower, as established by the engine manufacturer in his sales and service literature for vehicle application. A conventional automotive muffler of a size and

type commonly used with the engine being tested shall be employed in the exhaust system during smoke emission testing. The terminal 2 feet of the exhaust pipe shall be of circular cross section and be free of elbows and bends. The end of the pipe shall be cut off squarely. The terminal 2 feet of the exhaust pipe shall have a diameter in accordance with the engine being tested, as specified below:

Maximum rated horsepower	*Exhaust pipe size*
Less than 101	2"
101–200	3"
201–300	4"
301 or more	5"

(d) An engine air inlet system presenting an air inlet restriction within ±1-inch of water of the upper limit for the engine operating condition which results in maximum air flow, as established by the engine manufacturer in his sales and service literature, for the engine being tested.

§ 85.124 Smoke measurements system.

(a) *Schematic drawing.* The following figure (fig. 7) is a schematic drawing of the optical system of the light extinction meter.

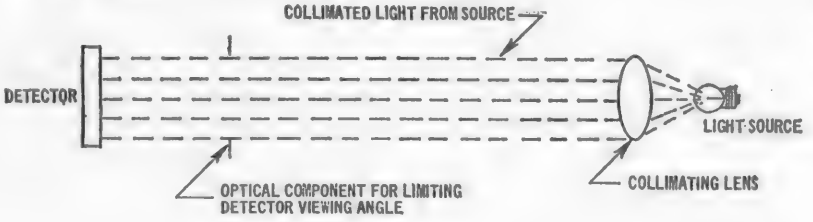


Figure 7. Typical smokemeter optical system (schematic).

(b) *Equipment.* The following equipment shall be used in the system:

(1) Adapter—the smokemeter optical unit may be mounted on a fixed or movable frame. The normal unrestricted shape of the exhaust plume shall not be modified by the adapter, the meter, or any ventilation system used to remove the exhaust from the test site.

(2) Smokemeter (light extinction meter)—continuous recording, full-flow light obscuration meter. It shall be positioned near the end of the exhaust pipe so that a built-in light beam traverses the exhaust smoke plume which issues from the pipe at right angles to the axis of the plume. The light source is an incandescent lamp operated at a constant voltage of not less than 15 percent of the manufacturer's specified voltage. The lamp output is collimated to a beam with a diameter which does not exceed 0.4 exhaust pipe diameters. The angle of divergence of the collimated beam shall be within 4° included angle. A light detector, directly opposed to the light source, measures the amount of light blocked by the smoke in the exhaust. The detector sensitivity is restricted to the visual range and comparable to that of the human eye. A collimating tube with apertures equal to the beam diameter is attached to the detector. It restricts the viewing angle of the detector to within 16° included angle. An amplified signal corresponding to the amount of light blocked is recorded continuously on a remote recorder. An air curtain across the light source and detector window assemblies may be used to minimize deposition of smoke particles on those surfaces provided that it does not measurably affect the opacity of the plume. The meter consists of two units, an optical unit and a remote control unit. Light extinction meters employing substantially identical measurement principles and producing substantially equivalent results but which employ other electronic and optical techniques may be used only after having been approved in advance by the Secretary.

(3) Recorder—a continuous recorder, with variable chart speed over a minimal range of 0.5 to 8.0 inches per minute (or equivalent) and an automatic marker indicating 1-second intervals shall be used for continuously recording the transient conditions of exhaust gas opacity, engine r.p.m. and torque. The recorder scale for opacity shall be linear and calibrated to read from 0 to 100 percent opacity full scale. The opacity trace shall have a resolution within 1 percent opacity. The recorder scale for engine r.p.m. and the recorder scale for observed engine torque shall be linear and shall have full scale calibration such as to facilitate chart reading. The r.p.m. trace shall have a resolution within 30 r.p.m. The torque trace shall have a resolution within 10 lb.-ft. Any means other than strip chart recorder may be used provided it produces a permanent visual data record of quality equal to or better than that described above.

(4) The recorder used with the smokemeter shall be capable of full-scale deflection in 0.5 second or less. The smokemeter-recorder combination may be damped so that signals with a frequency higher than 10 cycles per second are attenuated. A separate low-pass electronic filter with the following performance characteristics may be installed between the smokemeter and the recorder to achieve the high-frequency attenuation.

(i) 3 decibel point—10 cycles per second.

(ii) Insertion loss-zero ±0.5 decibels.

(iii) Selectivity—12 decibels per octave above 10 cycles per second.

(iv) Attenuation—27 decibles down at 40 cycles per second minimum.

(c) *Assembling equipment.* (1) The optical unit of the smokemeter shall be mounted radially to the exhaust pipe so that the measurement will be made at right angles to the axis of the exhaust plume. The distance from the optical unit to the exhaust pipe outlet shall be 1.0 to 1.5 pipe diameters but never less than 4 inches. The full flow of the exhaust stream shall be contained within and be centered about the light path of the unit.

(2) Power shall be supplied to the control unit of the smokemeter in time at least 15 minutes prior to testing to allow for stabilization.

§ 85.125 Information to be recorded.

The following information shall be recorded with respect to each test:

(a) Test number.
(b) Date and time of day.
(c) Instrument operator.
(d) Engine operator.
(e) Engine Identification numbers—Date of manufacture—Number of hours of operation accumulated on engine—Engine Family—Exhaust pipe diameter—Fuel injector type—Maximum measured fuel rate at maximum measured torque and horsepower—Air aspiration system—Low idle r.p.m.—Maximum governed r.p.m.—Maximum measured horsepower at r.p.m.—Maximum measured torque at r.p.m.—Exhaust system back pressure—Air inlet restriction.
(f) Smokemeter. Number—Zero control setting—Calibration control setting—Gain.
(g) Recorder chart. Identify zero traces—Calibration traces—Idle traces—Acceleration test traces—Start and finish of each test.
(h) Ambient temperature in dynamometer testing room.
(i) Engine intake air temperature and humidity.
(j) Barometric pressure.
(k) Observed engine torque.

§ 85.126 Instrument checks.

(a) The smokemeter shall be checked according to the following procedure prior to each test:

(1) The optical surfaces of the optical section shall be checked to verify that they are clean and free of foreign material and fingerprints.

(2) The zero control shall be adjusted under conditions of "no smoke" to give a recorder trace of zero.

(3) Calibrated neutral density filters having approximately 20 percent and 40 percent opacity shall be employed to check the linearity of the instrument. The filter(s) shall be inserted in the light path perpendicular to the axis of the beam and adjacent to the opening from which the beam of light from the light source emanates, and the recorder response shall be noted. Deviations in excess of 1 percent of the nominal opacity value of the filter as established by the Secretary shall be corrected.

(b) The instruments for measuring and recording engine r.p.m., engine torque, air inlet restrictions, exhaust system back pressure, etc., which are used in the tests prescribed herein shall be calibrated from time to time in accordance with good technical practice.

§ 85.127 Test run.

(a) The temperature of the air supplied to the engine shall be between 68° F. and 86° F. The observed barometric pressure shall be between 28.5 inches and 31 inches Hg. Higher air temperature or lower barometric pressure may be used, if desired, but no allowance will be made for possible increased smoke emissions because of such conditions.

(b) The governor and fuel system shall have been adjusted to provide engine performance at the levels specified by the engine manufacturer for maximum rated horsepower and maximum rated torque. These specifications shall be reported in accordance with § 85.51 (b)(3).

(c) The following steps shall be taken for each test:

(1) Start cooling system.

(2) Starting with a warmed engine, determine by experimentation the dynamometer inertia and dynamometer load required to perform the acceleration in the dynamometer cycle for smoke emission tests (§ 85.122(a)(2)). In a manner appropriate for the dynamometer and controls being used, arrange to conduct the acceleration mode.

(3) Install smokemeter optical unit and connect it to the recorder. Connect the engine r.p.m. and torque sensing devices to the recorder.

(4) Turn on purge air to the optical unit of the smokemeter, if purge air is used.

(5) Check and record zero and span settings of the smokemeter recorder at a chart speed of approximately 1 inch per minute. (The optical unit shall be retracted from its position about the exhaust stream if the engine is left running.)

(6) Precondition the engine by operating it for 10 minutes at maximum rated horsepower.

(7) Proceed with the sequence of smoke emission measurements on the engine dynamometer as prescribed in § 85.122.

(8) During the test sequence of § 85.-122, continuously record smoke measurements, engine r.p.m. and torque at a chart speed of approximately 1 inch per minute minimum during the idle mode and transitional modes and 8 inches per minute minimum during the acceleration and lugging modes.

(9) Turn off engine.

(10) Check zero and reset if necessary and check span of the smokemeter recorder by inserting neutral density filters. If either zero or span drift is in excess of 2 percent opacity, the test results shall be invalidated.

§ 85.128 Chart reading.

(a) The following procedure shall be employed in reading the smokemeter recorder chart.

(1) Locate the acceleration mode (§ 85.122(a)(2)) and the lugging mode (§ 85.122(a)(3)) on the chart. Divide each mode into ½-second intervals beginning at the start of each mode. Determine the average smoke reading during each ½-second interval except those recorded during the transitional portions of the acceleration mode (§ 85.122(a)(2)(iii)) and the lugging mode (§ 85.122(a)(3)(i)).

(2) Locate and record the 15 highest ½-second readings during the acceleration mode of each dynamometer cycle.

(3) Locate and record the five highest ½-second readings during the lugging mode of each dynamometer cycle.

§ 85.129 Calculations.

(a) Average the 45 readings in § 85.128 (a)(2) and designate the value as "a".

(b) Average the 15 readings in § 85.128 (a)(3) and designate the value as "b".

§ 85.130 Test engines.

(a) The engines covered by the application for certification will be divided into engine families based upon the criteria outlined in § 85.89(a).

(b) Emission data engines:

(1) Engines will be chosen to be run for emission data based upon engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(2) Engines of each engine family will be divided into groups based upon exhaust emission control system. Two engines of each engine-system combination shall be run for smoke emission data as prescribed in § 85.132(b). Within each combination, the engines that feature the highest fuel feed per stroke, primarily at the speed of maximum rated torque and secondarily at rated speed, will be selected. In the case where more than one engine in an engine-system combination have the highest fuel feed per stroke, the engine with the highest maximum rated torque will be selected.

(c) Durability data engines:

(1) One engine from each engine-system combination shall be tested for lifetime smoke emission data as prescribed in § 85.132(c). Within each combination, the engine which features the highest fuel feed per stroke, primarily at rated speed and secondarily at the speed of maximum rated torque, will be selected for durability testing. In the case where more than one engine in an engine-system combination has the highest fuel feed per stroke, the engine with the highest maximum rated horsepower will be selected for durability testing.

(2) A manufacturer may elect to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same model and fuel system as the engine selected in accordance with the provisions of subparagraph (1) of this paragraph. Notice of an intent to test additional engines shall be given to the Secretary not later than 30 days following notification of the test fleet selection.

(d) Any manufacturer whose projected sales of new motor vehicle engines subject to this subpart for the model year for which certification is sought is less than 200 engines may request a reduction in the number of test engines determined in accordance with the foregoing provisions of this section. The Secretary may agree to such lesser number as he determines would meet the objectives of this procedure.

(e) In lieu of testing an emission data or durability data vehicles elected under paragraph (b) or (c) of this section and submitting data therefor, a manufacturer may, with the prior written approval of the Secretary, submit data on a similar vehicle for which certification has previously been obtained.

§ 85.131 Maintenance.

(a) (1) Maintenance on the engines and fuel systems of durability engines may be performed only under the following provisions:

(i) One major engine servicing to manufacturer's specifications may be performed at 500 hours (±8 hours) of dynamometer operation. A major engine servicing shall be restricted to the following:

(a) Adjust drive belt tension.
(b) Adjust low idle speed.
(c) Adjust valve lash if required.
(d) Adjust injector timing.
(e) Adjust governor.
(f) Check engine bolt torque and tighten as required.
(g) Clean injector tips.

(ii) Injectors may be changed if a persistent misfire is detected.

(iii) Normal engine lubrication services (engine oil change and oil filter, fuel filter, and air filter servicing) will be allowed at manufacturer's recommended intervals.

(iv) Readjustment of the engine fuel rates may be performed only if there is a problem of dropping below 95 percent of maximum rated horsepower at 95–100 percent rated speed.

(v) Leaks in the fuel system, engine lubrication system and cooling system may be repaired.

(vi) Any other engine or fuel system maintenance or repairs will be allowed only with the advanced approval of the Secretary.

(2) Allowable maintenance on emission data engines shall be limited to the adjustment of engine low idle speed at the 125-hour test point.

(b) Complete emission tests (see §§ 85.121–85.129) shall be run before and after any engine maintenance which may reasonably be expected to affect emissions. These test data shall be supplied to the Secretary immediately after the tests, along with a complete record of all pertinent maintenance, including an engineering report of any malfunction diagnosis and the corrective action taken. In addition, all test data and maintenance reports shall be compiled and provided to the Secretary in accordance with § 85.53.

(c) If the Secretary determines that maintenance or repairs performed have resulted in a substantial change to the engine-system combination, the engine shall not be used as a durability data engine.

§ 85.132 Service accumulation and emission measurements.

Service accumulation shall be accomplished by operation of an engine on a dynamometer.

(a) Emission data engines: Each engine shall be operated on a dynamometer for 125 hours with the dynamometer and engine adjusted so that the engine is operating at 95–100 percent of rated speed and at least 95 percent of maximum rated horsepower. During such operation, the engine shall be run at the exhaust back pressure specified in § 85.123(c) and the air inlet restriction specified in § 85.123(d). Exhaust smoke tests shall be conducted at zero and 125 hours of operation.

(b) Durability data engines: Each engine shall be operated on a dynamometer for 1,000 hours with the dynamometer and engine adjusted so that the engine is operating at 95–100 percent of rated speed and at least 95 percent of maximum rated horsepower. During such operation, the engine shall be run at the exhaust back pressure specified in § 85.123(c) and the air inlet restriction specified in § 85.123(d). Exhaust smoke measurements shall be made at zero hours and at each 125 hours of operation. All results except the zero hour results shall be used to establish the deterioration factors (see § 85.133).

(c) All tests required by this subpart to be conducted after 125 hours of dynamometer operation or at any multiple of 125 hours may be conducted at any accumulated hours within 8 hours of 125 hours or the appropriate multiple of 125 hours, respectively.

(d) The results of each emission test shall be supplied to the Secretary immediately after the test. In addition, all test data shall be compiled and provided to the Secretary in accordance with § 85.53.

(e) Whenever the manufacturer proposes to operate and test an engine which may be used for emission or durability data, he shall provide the zero hour test data to the Secretary and make the engine available for such testing under § 85.54 as the Secretary may require before beginning to accumulate hours on the engine. Failure to comply with this requirement shall invalidate all test data submitted for this engine.

(f) Once a manufacturer begins to operate an emission data or durability data engine, as indicated by compliance with paragraph (e) of this section, he shall continue to run the engine to 125 hours or 1,000 hours, respectively, and the data from the engine shall be used in the calculations under § 85.133. Discontinuation of an engine shall be allowed only with the prior written consent of the Secretary.

§ 85.133 Compliance with emission standards.

(a) The emission standards in the regulations in this part apply to the lifetime emission of engines in public use. Prior to certification, lifetime emissions can be obtained by projection of test data to lifetime normal service. Lifetime normal service or its equivalent is taken to be 2,000 hours of prescribed dynamometer operation.

(b) It is expected that the opacity of exhaust emissions will change with use of the engine. It is assumed that the emission level corresponding to 1,000 hours of prescribed dynamometer operation is the average emission of an engine over its lifetime.

(c) The procedure for determining compliance with exhaust smoke emission standards in heavy duty diesel engines is as follows:

(1) Emission deterioration factors for the acceleration mode (designated as "A") and the lugging mode (designated as "B") shall be established separately for each engine-system combination.

(i) The applicable results to be used in determining the deterioration factors for each combination shall be:

(*a*) All emission data from the tests required under § 85.132(b), except the zero hour tests. This shall include the official test results, as determined in § 85.54, for all tests conducted on all durability engines of the combination selected under § 85.130(c) (including all engines elected to be operated by the manufacturer under § 85.130(c)(3)).

(*b*) All emission data from the tests conducted before and after the maintenance provided in § 85.131(a)(1)(i).

(ii) All applicable results shall be plotted as a function of the hours on the system, rounded to the nearest hour, and the best fit straight lines, fitted by the method of least squares, shall be drawn through these data points. The interpolated 125 and 1,000 hour points on this line must be within the standard provided in § 85.41 or the data shall not be used in calculation of a deterioration factor.

(iii) The deterioration factors will be calculated as follows:

A-percent opacity "a", interpolated to 1,000 hours, minus percent opacity "a," interpolated to 125 hours.

B-percent opacity "b", interpolated to 1,000 hours, minus percent opacity "b", interpolated to 125 hours.

(2) The "percent opacity" values to compare with the standards shall be the opacity values "a" and "b" for each emission data engine within an engine-system combination to which are added the respective factors "A" and "B" of subparagraph (1) of this paragraph for that engine-system combination: *Provided*, That if a deterioration factor as computed in subparagraph (1) of this paragraph is less than zero, that deterioration factor shall be zero for the purposes of this subparagraph.

(3) Every test engine of an engine family must comply with all applicable standards, as determined in subparagraph (2) of this paragraph, before any engine in that family will be certified.

APPENDIX A

DHEW URBAN DYNAMOMETER DRIVING SCHEDULE

(Speed versus Time Sequence)[1]

Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)
0	0.0	94	30.2	205	47.2
20	0.0	95	30.3	206	47.2
21	2.7	96	30.5	207	47.1
22	5.1	97	30.1	208	47.1
23	7.5	98	29.7	209	47.0
24	10.4	99	29.7	214	47.0
25	14.4	100	29.9	215	47.2
26	16.6	101	30.2	216	47.8
27	18.3	102	30.6	217	48.2
28	19.0	103	30.8	218	48.7
29	20.2	104	30.8	219	49.2
30	21.8	105	30.3	220	49.7
31	22.1	106	29.9	221	50.2
32	22.3	107	29.8	222	50.6
33	22.0	108	29.9	223	51.1
34	21.5	109	30.3	224	52.2
35	21.1	110	30.9	225	53.2
36	20.7	111	31.3	226	53.9
37	19.9	112	32.0	227	54.3
38	17.5	114	32.0	228	54.5
39	15.2	115	31.9	229	54.8
40	15.0	116	31.0	230	54.8
41	15.1	117	28.7	231	54.4
42	15.2	118	24.6	232	54.4
43	15.7	119	20.0	233	54.6
44	16.6	120	15.3	234	54.9
45	18.6	121	11.7	235	55.2
46	20.5	122	6.5	236	55.4
47	22.1	123	2.8	237	55.8
48	22.8	124	0.0	238	55.9
49	22.6	163	0.0	239	56.0
50	22.5	164	0.2	240	56.1
51	21.5	165	4.0	241	56.2
52	19.3	166	9.6	242	56.2
53	17.7	167	14.3	243	56.2
54	16.1	168	16.5	244	56.3
55	15.5	169	20.0	245	56.2
56	16.8	170	22.4	247	56.2
57	18.5	171	24.2	248	56.1
58	20.5	172	25.7	249	56.0
59	22.4	173	26.5	250	55.7
60	23.8	174	25.9	251	55.1
61	24.2	175	25.5	252	54.8
62	24.6	176	25.0	253	54.3
63	24.8	177	25.1	254	54.1
64	24.6	178	25.5	255	53.9
65	24.4	179	25.7	256	53.7
66	24.5	180	26.0	257	53.7
69	24.5	181	27.0	258	53.6
70	24.6	182	26.4	259	53.9
71	24.8	183	24.8	260	54.0
72	25.1	184	22.2	261	53.8
73	25.4	185	19.5	262	53.4
74	25.4	186	18.0	263	53.1
75	25.2	187	17.6	264	52.8
76	25.1	188	18.5	265	52.2
77	25.2	189	18.8	266	52.1
78	25.7	190	20.3	267	52.0
79	26.0	191	22.5	268	51.8
81	26.0	192	24.9	269	51.6
82	26.2	193	27.8	270	51.5
83	27.0	194	31.0	271	51.4
84	28.0	195	34.3	272	51.5
85	29.0	196	36.4	273	51.8
86	29.3	197	37.8	274	52.0
87	29.7	198	39.4	275	52.6
88	30.0	199	40.8	276	53.2
89	30.4	200	42.0	277	53.6
90	30.5	201	43.7	278	54.2
91	30.4	202	44.9	279	54.9
92	30.3	203	45.8	280	55.2
93	30.3	204	46.5	281	55.5

[1] Where time and speed are omitted from the sequence, the time and speed immediately preceding and following the omission(s) apply.

APPENDIX A—Continued

Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)
282	55.7	379	36.2	493	31.5
283	55.5	380	36.2	494	29.5
284	55.2	381	36.1	495	27.5
285	54.7	382	36.0	496	25.0
286	53.9	383	35.3	497	22.0
287	53.0	384	34.5	498	18.9
288	51.8	385	33.6	499	15.5
289	51.4	386	31.5	500	12.5
290	51.2	387	28.0	501	10.0
291	51.2	388	25.3	502	6.2
292	50.4	389	23.0	503	2.5
293	49.8	390	20.2	504	0.0
294	49.8	391	17.0	505	1.0
295	49.9	392	14.3	506	3.2
296	49.7	393	11.2	507	5.0
297	49.5	394	7.5	508	6.1
298	49.4	395	4.0	509	7.8
299	49.3	396	0.8	510	9.0
300	49.2	397	0.0	511	10.0
301	48.9	402	0.0	512	11.0
302	48.0	403	2.1	513	13.2
303	47.6	404	6.0	514	15.3
304	46.8	405	10.6	515	16.9
305	45.4	406	14.0	516	18.0
306	44.3	407	16.9	517	19.1
307	43.1	408	20.0	518	20.3
308	42.0	409	23.0	519	21.2
309	40.7	410	24.7	520	22.2
310	39.5	411	25.8	521	23.3
311	38.0	412	27.6	522	23.9
312	36.4	413	29.2	523	24.5
313	34.6	414	29.8	524	25.1
314	33.2	415	30.0	529	25.1
315	32.1	416	29.8	530	25.5
316	31.1	417	29.5	531	26.0
317	30.8	418	29.2	532	26.0
318	30.8	419	28.7	533	25.9
319	30.0	420	27.5	534	25.8
320	28.5	421	24.8	535	25.5
321	26.0	422	21.0	536	25.2
322	23.5	423	17.0	537	25.2
323	21.1	424	13.4	538	25.0
324	20.0	425	10.0	539	24.8
325	18.9	426	5.3	540	24.5
326	17.7	427	1.5	541	23.5
327	16.2	428	0.0	542	17.5
328	13.8	445	0.0	543	12.0
329	11.5	446	0.3	544	7.5
330	8.6	447	3.0	545	1.8
331	6.0	448	8.0	546	0.0
332	1.5	449	13.0	567	0.0
333	0.2	450	14.5	568	2.5
334	0.0	451	17.0	569	5.3
347	0.0	452	20.1	570	8.5
348	2.0	453	22.5	571	12.2
349	7.2	454	25.2	572	14.9
350	10.7	455	27.1	573	15.7
351	13.5	456	28.1	574	16.9
352	16.5	457	30.3	575	17.1
353	18.9	458	32.1	576	17.0
354	21.0	459	33.0	577	17.5
355	23.2	460	34.1	578	18.0
356	24.6	461	35.0	579	18.0
357	26.1	462	35.3	580	17.9
358	28.0	463	35.8	581	17.9
359	29.1	464	35.9	582	17.2
360	30.7	465	36.0	583	17.1
361	31.1	466	36.0	584	17.1
362	31.8	467	35.9	585	17.2
363	32.5	468	35.8	586	17.1
364	33.2	469	35.8	587	17.0
365	33.9	470	35.9	591	17.0
366	34.2	471	35.8	592	17.2
367	34.7	472	35.7	593	18.2
368	34.3	473	35.5	594	18.8
369	34.1	474	35.4	595	20.0
370	34.5	475	35.2	596	20.9
371	35.2	479	35.2	597	21.0
372	35.8	480	35.1	598	21.1
373	35.7	481	35.0	599	21.5
374	35.8	487	35.0	600	21.9
375	35.9	488	34.9	601	22.2
376	36.0	490	34.9	602	22.4
377	36.1	491	34.0	603	22.5
378	36.1	492	33.2	604	22.4

APPENDIX A—Continued

Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)
605	22.4	724	3.9	813	33.9
606	23.5	725	3.0	814	33.5
607	25.0	726	1.3	815	33.2
608	26.0	727	0.2	816	32.9
609	26.5	728	2.0	817	32.4
610	27.0	729	5.6	818	32.0
611	27.4	730	9.2	819	31.9
612	27.8	731	12.0	820	31.8
613	24.8	732	13.7	821	31.2
614	19.5	733	15.6	822	30.3
615	16.0	734	17.5	823	30.0
616	11.0	735	19.3	826	30.0
617	3.0	736	21.0	827	29.9
618	0.2	737	22.5	828	29.8
619	0.0	738	24.2	829	29.7
644	0.0	739	25.4	830	29.5
645	2.0	740	26.2	831	29.2
646	3.9	741	27.0	832	28.9
647	6.6	742	27.5	833	28.3
648	9.3	743	27.9	834	27.5
649	11.3	744	28.1	835	26.3
650	13.5	745	28.6	836	24.5
651	14.3	746	28.4	837	22.8
652	16.3	747	28.3	838	21.2
653	18.2	748	28.1	839	19.8
654	20.2	749	28.0	840	19.2
655	21.6	750	27.8	841	20.2
656	22.9	751	27.2	842	21.1
657	24.2	752	26.2	843	21.7
658	25.1	753	24.0	844	22.2
659	25.4	754	21.5	845	23.0
660	25.8	755	19.6	846	23.6
661	26.0	756	18.0	847	24.6
663	26.0	757	15.6	848	25.2
664	25.9	758	13.8	849	26.2
665	26.2	759	10.5	850	26.8
666	26.6	760	7.5	851	26.8
667	26.3	761	3.5	852	26.7
668	26.1	762	1.5	853	26.7
669	25.0	763	1.5	854	27.3
670	22.9	764	1.0	855	27.8
671	20.3	765	0.0	856	28.2
672	18.0	766	2.0	857	28.7
673	15.5	767	5.2	858	28.9
674	13.6	768	8.8	859	29.0
675	10.4	769	12.5	860	29.2
676	7.8	770	15.4	861	28.9
677	4.5	771	17.5	862	28.4
678	2.9	772	18.3	863	28.0
679	1.5	773	19.0	864	27.5
680	0.1	774	20.5	865	26.2
681	0.0	775	21.9	866	25.3
691	0.0	776	23.2	867	25.0
692	0.1	777	24.8	868	25.1
693	0.5	778	26.2	869	25.3
694	2.1	779	27.2	870	25.5
695	3.7	780	28.0	871	25.7
696	5.1	781	28.2	872	26.2
697	8.0	782	28.8	873	26.8
698	10.7	783	29.1	874	27.4
699	12.8	784	29.0	875	28.0
700	14.3	785	29.0	876	29.0
701	15.6	786	28.9	877	29.3
702	16.8	787	28.7	878	29.2
703	16.7	788	28.6	879	29.1
704	16.5	789	28.5	880	29.0
705	17.5	790	28.3	881	28.9
706	18.8	791	27.9	882	28.9
707	20.0	792	27.9	883	28.8
708	20.7	793	28.0	884	28.4
709	22.2	794	27.7	885	28.3
710	22.5	795	27.8	886	28.0
711	22.1	798	27.8	887	27.9
712	22.2	799	28.0	888	27.4
713	22.8	800	28.7	889	27.1
714	23.5	801	29.7	890	27.5
715	23.0	802	30.8	891	27.8
716	22.1	803	32.0	892	28.0
717	21.5	804	32.8	893	27.9
718	19.8	805	33.0	894	28.0
719	17.5	806	33.3	895	28.0
720	13.5	807	33.8	896	28.1
721	9.8	808	34.1	897	28.0
722	6.9	809	34.0	898	27.8
723	5.0	812	34.0	899	27.3

APPENDIX A—Continued

Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)
900	26.9	986	24.0	1,102	2.0
901	26.8	987	22.7	1,103	4.4
902	26.7	988	21.7	1,104	7.3
903	26.6	989	21.8	1,105	10.5
904	26.6	990	22.0	1,106	13.1
905	26.5	991	22.5	1,107	13.9
906	26.4	992	22.9	1,108	14.4
907	25.9	993	23.0	1,109	16.0
908	25.8	996	23.0	1,110	18.1
909	25.8	997	22.9	1,111	19.8
910	25.8	998	23.0	1,112	20.9
911	26.0	999	23.5	1,113	21.0
912	26.1	1,000	24.2	1,114	21.1
913	25.5	1,001	24.9	1,115	21.2
914	24.2	1,002	25.1	1,116	21.6
915	22.6	1,003	25.3	1,117	22.0
916	22.0	1,004	25.9	1,118	22.7
917	21.8	1,005	26.0	1,119	23.3
918	22.0	1,006	25.6	1,120	24.3
919	22.5	1,007	25.0	1,121	24.9
920	23.0	1,008	24.5	1,122	24.9
921	23.8	1,009	23.9	1,123	25.0
922	24.3	1,010	23.7	1,124	25.1
923	24.5	1,011	23.0	1,125	25.2
924	24.9	1,012	22.7	1,126	25.7
925	25.1	1,013	22.2	1,127	26.0
926	25.2	1,014	21.8	1,128	26.3
927	25.2	1,015	21.0	1,129	26.7
928	25.3	1,016	18.8	1,130	27.0
929	25.2	1,017	15.0	1,132	27.0
930	25.0	1,018	11.2	1,133	26.9
932	25.0	1,019	7.2	1,134	26.9
933	24.9	1,020	3.0	1,135	26.9
934	24.8	1,021	0.0	1,136	26.8
935	24.7	1,051	0.0	1,137	26.7
936	24.5	1,052	1.5	1,138	26.5
937	24.5	1,053	4.6	1,139	26.1
938	24.9	1,054	8.0	1,140	25.6
939	25.0	1,055	11.2	1,141	25.1
940	24.9	1,056	14.2	1,142	23.8
941	24.9	1,057	17.0	1,143	22.1
942	24.2	1,058	18.2	1,144	20.1
943	24.3	1,059	19.9	1,145	18.2
944	25.1	1,060	21.8	1,146	16.3
945	25.8	1,061	22.8	1,147	14.5
946	25.5	1,062	23.8	1,148	12.5
947	24.0	1,063	24.9	1,149	8.7
948	22.0	1,064	25.6	1,150	4.8
949	20.0	1,065	26.5	1,151	0.6
950	18.9	1,066	26.8	1,152	0.0
951	16.6	1,067	27.2	1,167	0.0
952	12.6	1,068	28.0	1,168	0.1
953	7.6	1,069	28.1	1,169	4.3
954	5.0	1,070	28.0	1,170	9.7
955	1.2	1,071	27.7	1,171	13.5
956	0.1	1,072	27.0	1,172	16.2
957	0.0	1,073	26.9	1,173	19.3
958	0.0	1,074	26.4	1,174	21.2
959	0.8	1,075	24.8	1,175	23.0
960	4.4	1,076	22.5	1,176	23.6
961	9.0	1,077	21.8	1,177	23.0
962	13.9	1,078	21.1	1,178	22.0
963	15.9	1,079	18.8	1,179	19.5
964	17.2	1,080	15.0	1,180	16.6
965	18.5	1,081	12.9	1,181	11.6
966	20.0	1,082	11.1	1,182	7.5
967	21.3	1,083	10.8	1,183	3.5
968	22.2	1,084	10.2	1,184	0.2
969	23.0	1,085	9.7	1,185	0.0
970	24.8	1,086	9.3	1,195	0.0
971	26.2	1,087	9.0	1,196	1.0
972	27.1	1,088	8.9	1,197	2.5
973	27.8	1,089	9.0	1,198	4.8
974	28.2	1,090	9.0	1,199	8.0
975	28.3	1,091	8.9	1,200	10.9
976	28.3	1,092	8.7	1,201	12.5
977	28.2	1,093	8.3	1,202	12.8
978	28.0	1,094	7.2	1,203	13.1
979	27.7	1,095	5.5	1,204	12.9
980	27.3	1,096	4.6	1,205	13.0
981	27.0	1,097	3.3	1,206	13.1
982	26.8	1,098	1.8	1,207	13.5
983	26.2	1,099	0.0	1,208	14.2
984	26.0	1,100	0.3	1,209	15.4
985	25.3	1,101	0.8	1,210	17.0

APPENDIX A—Continued

Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)	Time (sec.)	Speed (m.p.h.)
1,211	19.0	1,260	7.2	1,303	28.2
1,212	20.2	1,261	9.0	1,304	26.5
1,213	21.7	1,262	10.9	1,305	23.1
1,214	21.8	1,263	10.5	1,306	19.6
1,215	21.8	1,264	9.5	1,307	15.0
1,216	21.9	1,265	8.4	1,308	9.3
1,217	21.4	1,266	8.1	1,309	4.0
1,218	21.2	1,267	9.7	1,310	0.3
1,219	21.3	1,268	12.5	1,311	0.0
1,220	21.9	1,269	15.0	1,336	0.0
1,221	21.9	1,270	18.0	1,337	1.8
1,222	21.8	1,271	20.3	1,338	5.6
1,223	21.7	1,272	21.3	1,339	9.7
1,224	21.6	1,273	22.0	1,340	12.0
1,225	21.5	1,274	22.5	1,341	14.0
1,226	21.2	1,275	23.5	1,342	15.8
1,227	20.5	1,276	24.0	1,343	17.5
1,228	19.8	1,277	24.3	1,344	19.0
1,229	19.4	1,278	24.6	1,345	19.9
1,230	19.8	1,279	24.2	1,346	20.5
1,231	20.0	1,280	24.0	1,347	21.6
1,232	20.0	1,281	23.7	1,348	22.0
1,233	18.9	1,282	23.5	1,349	22.4
1,234	17.0	1,284	23.5	1,350	22.4
1,235	14.9	1,285	23.6	1,351	22.0
1,236	12.0	1,286	23.7	1,352	21.6
1,237	9.5	1,287	24.0	1,353	21.2
1,238	7.4	1,288	24.5	1,354	21.0
1,239	5.6	1,289	24.8	1,355	20.0
1,240	3.2	1,290	25.0	1,356	19.7
1,241	2.1	1,291	25.2	1,357	18.3
1,242	0.1	1,292	25.5	1,358	17.2
1,243	0.0	1,293	25.8	1,359	16.2
1,249	0.0	1,294	26.0	1,360	15.2
1,250	0.7	1,295	26.1	1,361	13.5
1,251	1.1	1,296	26.3	1,361	11.0
1,254	1.1	1,297	27.2	1,363	7.8
1,255	1.2	1,298	28.0	1,364	5.0
1,256	2.5	1,299	28.5	1,365	1.5
1,257	3.8	1,300	28.8	1,366	0.0
1,258	4.8	1,301	29.0	1,370	0.0
1,259	6.0	1,302	28.8		

APPENDIX B

PROCEDURE FOR DYNAMOMETER ROAD HORSEPOWER CALIBRATION

This appendix describes the method for determining the road horsepower absorbed by a chassis dynamometer. The measured absorbed road horsepower includes the dynamometer friction as well as the power absorbed by the power absorption unit. The dynamometer is driven above the test speed range. The device used to drive the dynamometer is then disengaged from the dynamometer and the roll(s) is allowed to coast down. The kinetic energy of the system is dissipated by the dynamometer friction and absorption unit. This method neglects the variations in roll bearing friction due to the drive axle weight of the vehicle. The difference in coast down time of the free (rear) roll relative to the drive (front) roll may be neglected in the case of Clayton or similar type dynamometers.

This procedure shall be followed:

1. Devise a method to determine the speed of the drive roll if not already measured. A fifth wheel, revolution pickup or other suitable means may be used.
2. Place a vehicle on the dynamometer or devise another method of driving the dynamometer.
3. Engage inertia flywheel for the most common vehicle weight class for which the dynamometer is used.
4. Drive dynamometer up to 50 m.p.h.
5. Record indicated road horsepower.
6. Drive dynamometer up to 60 m.p.h.
7. Disengage the device used to drive the dynamometer.
8. Record the time for the dynamometer drive roll to coast down from 55 m.p.h. to 45 m.p.h.
9. Adjust the power absorption unit to a different level.
10. Repeat steps 4 to 9 above sufficient times to cover the range of road horsepower used.
11. Calculate absorbed road horsepower from:

$HP_d = (1/2)\ (W_I/32.2)\ (V_1^2 - V_2^2)/(550t)$

$HP_d = 0.06073\ (W_I/t)$

Where:

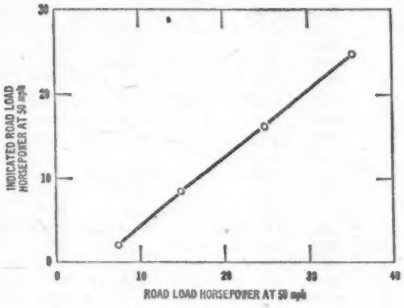
W_I = Equivalent inertia in lb.

V_1 = Initial velocity in ft./sec. (55 m.p.h. = 80.67 ft./sec.).

V_2 = Final velocity in ft./sec. (45 m.p.h. = 66 ft./sec.).

t = Elapsed time for rolls to coast from 55 m.p.h. to 45 m.p.h.

12. Plot indicated road load horsepower at 50 m.p.h. versus road load horsepower at 50 m.p.h.



EXAMPLE: Dynamometer calibration curve (Ser. No. CN-256-H) 6-24-69

13. The road load horsepower reported in § 85.76 is obtained by entering the plot at the indicated road load horsepower determined in § 85.76, (c), (1), (ii).

14. Once the road load horsepower at 50 m.p.h. is known for a vehicle, it may be tested on other dynamometers using a similar calibration.

APPENDIX C

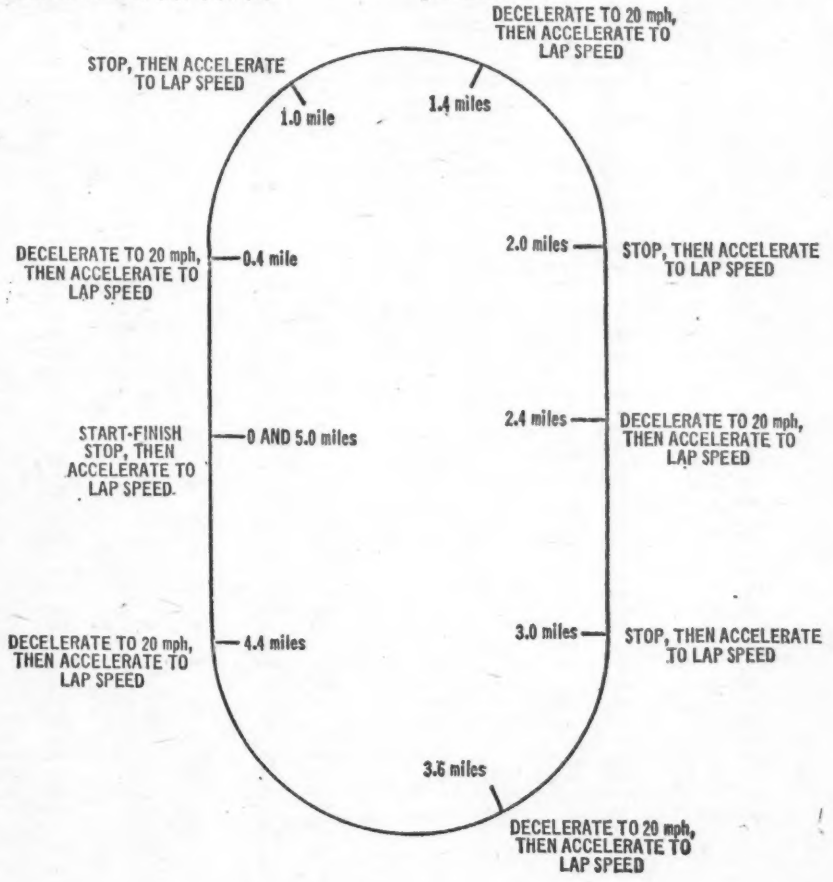
DURABILITY DRIVING SCHEDULE

The schedule consists of 10 laps of a 5-mile course. The vehicle speed for each lap is as follows:

Lap	Speed m.p.h.
1	40
2	30
3	55
4	40
5	30
6	55
7	35
8	55
9	45
10	35

The third, sixth, and eighth laps are run at a constant speed of 55 m.p.h. All other laps are run as described in the following diagram with all accelerations at a rate of 2.2 m.p.h./sec.^{2} and all decelerations at a rate of 2.0 m.p.h./sec.^{2}.

This 10 lap procedure shall be followed for 4 hour intervals, with cool down periods between intervals. During each cool down, the vehicle shall be parked and shall soak at ambient temperature for no less than 4 hours. An accelerated cool down technique may be used if approved in advance by the Secretary as meeting the objectives of this provision.


DECELERATE TO 20 mph, THEN ACCELERATE TO LAP SPEED
STOP, THEN ACCELERATE TO LAP SPEED
1.0 mile
1.4 miles
DECELERATE TO 20 mph, THEN ACCELERATE TO LAP SPEED
0.4 mile
2.0 miles
STOP, THEN ACCELERATE TO LAP SPEED
START-FINISH STOP, THEN ACCELERATE TO LAP SPEED.
0 AND 5.0 miles
2.4 miles
DECELERATE TO 20 mph, THEN ACCELERATE TO LAP SPEED
DECELERATE TO 20 mph, THEN ACCELERATE TO LAP SPEED
4.4 miles
3.0 miles
STOP, THEN ACCELERATE TO LAP SPEED
3.6 miles
DECELERATE TO 20 mph, THEN ACCELERATE TO LAP SPEED

NOTE: All stops are for 15 seconds.

[F.R. Doc. 70-8932; Filed, July 14, 1970; 8:45 a.m.]